ELECTRICAL REVIEW

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21 MAY 1954

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VOLUME 154 ✧ NUMBER 21

Eighty-Second Year of Publication

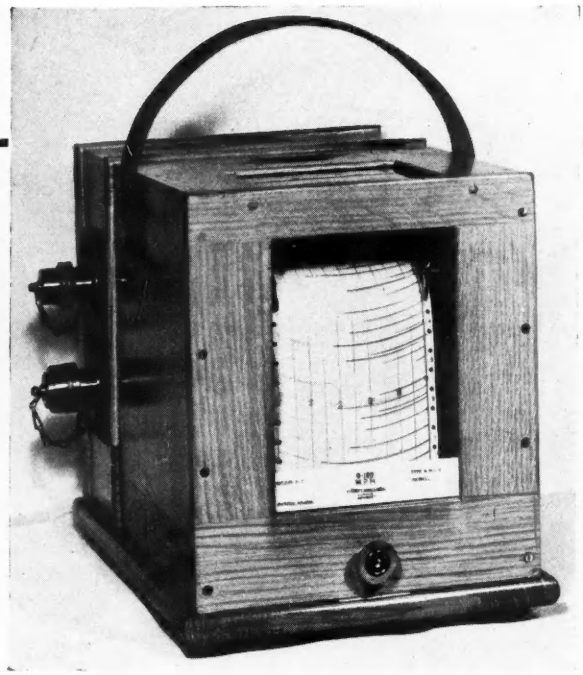
FRIDAY ✧ ONE SHILLING

Editorial, Advertising and Publishing Offices: Dorset House, Stamford Street, London, S.E.1. Telegraphic Address: "Elecrev, Sedist, London." Code: ABC. Telephone No. Waterloo 3333 (60 lines). Entered as Second Class Matter at the New York, U.S.A., Post Office. Annual Subscription: Home and Overseas £3 6s 0d: U.S.A. and Canada $11.00. Cheques & P.O.s (on Chief Office, London) payable to ELECTRICAL REVIEW PUBLICATIONS LTD., and crossed "Lloyds Bank."

TRAIN SPEED RECORDER

"Inkwell" Pattern

Patent No. 665669



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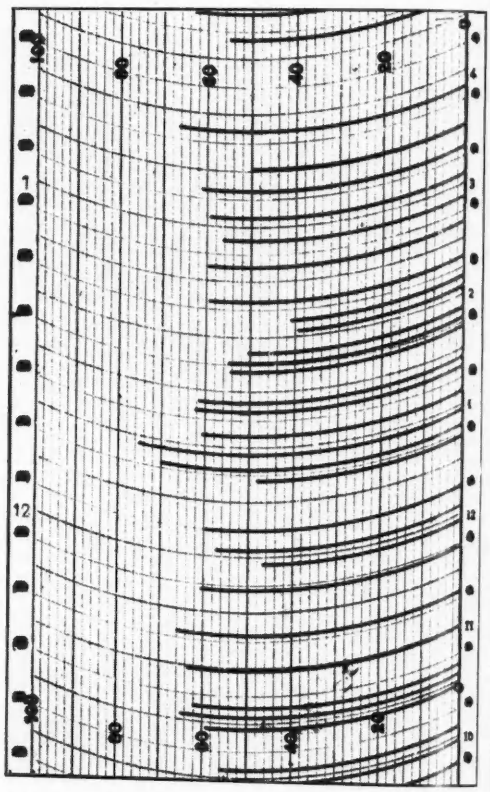

The record illustrated was made on a main line on the outskirts of London, chart speed 1 in per hour, and shows the passing of a number of express trains.

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ELECTRICAL REVIEW

21 May 1954 Vol. 154 No. 21 Established 1872

Railway Electrification

THE International Railway Congress now being held in London presents an excellent opportunity for putting forward the claims of electric traction. It was at the Cairo Congress in 1933 that the relative merits of electric and steam traction were compared; the London Congress is concerned with the choice of electrical systems, although in his report on the various methods Mr. S. B. Warder (chief officer (electrical engineering), British Railways) makes a brief reference to the advantages of electrification.

To meet the need for a statement of the case for railway electrification, with particular reference to Great Britain, we have asked several authorities on the subject to deal with it from their various aspects and this issue is devoted to that purpose. Apart from the public itself, which has shown its preference for electric trains, the people mainly concerned are the railway operators, the manufacturers of electric traction equipment and the electricity supply authorities.

As an operator, Mr. S. W. Smart, superintendent of operation, Southern Region, British Railways, is in no doubt of the benefits which the Southern Region has derived from electrification. He shows how working has been simplified, particularly at termini, by the adaptability of electric stock, which has also led to considerable economies. Rapid acceleration has permitted more intensive working and punctuality has been achieved.

Speaking for the manufacturers, Messrs. E. T. Hippisley and J. C. Way mention what the British electrical industry has already accomplished in the realm of electric traction equipment and affirm the ability of the industry to meet future demands. They stress the need for a substantial home market as a basis for overseas business and the value of a regular volume of home traction orders such as the electrification of British railways would ensure.

Regarding electrification from the British Electricity Authority's point of view, Mr. W. B. Noddings estimates that the conversion of 4,000 route miles of heavy-traffic lines over a fifteen-year period would represent an extra demand of 60 MW each year. This is a very small proportion of the annual addition to the B.E.A.'s capacity—already about 1,500 MW—and one which the B.E.A. could take in its stride.

So far so good. But what of the cost and the return? These aspects are covered by Mr. C. M. Cock in the general introduction which he contributes. Mr. Cock does not blink the fact that the cost of main-line electrification would be high but he believes it to be necessary to spend the money. He puts the cost of electrifying 280 route miles a year at £24 million, pointing out that this represents only 1 per cent of the total gross fixed investment of the United Kingdom for 1953.

The railways are essential but at present are obviously not paying their way or fully meeting public needs. Electrification would rejuvenate them and, additionally, would benefit the country in a number of directions.

B.E.A. INTO C.E.A.

During the committee stage of the Electricity Reorganization (Scotland) Bill the Government accepted an amendment providing for the changing of the name of the British Electricity Authority to " Central Electricity Authority." In point of fact this change is in consonance with the 1947 Electricity Act which set up the B.E.A. Section 1 (3) of the Act begins as follows:—

> " In this Act and in any amendment made by this Act in any other enactment the British Electricity Authority is referred to as ' the Central Authority ' . . ."

But this was for convenience of reference and its use for normal purposes is to be deprecated as savouring of " centralization," which everybody seems anxious to avoid. It will, moreover, cause much unnecessary trouble and expense to the Authority. For instance, the B.E.A. has endeavoured to popularize the term " British Electricity," dropping the rather threatening " Authority," and its magazine bears that title. The Authority will still be " British " in so far as it embodies Wales and in any event will not be confused with the proposed South of Scotland Electricity Board. In short the change appears to be difficult to justify.

INCREASED CABLE RATINGS

In the *Electrical Review* of 19th February last we were pleased to be able to draw attention to a real service given to the electrical industry by the Cable Makers' Association in preparing and issuing a set of tables giving rating factors for various types of aluminium cables installed under different conditions of service. A further progressive step by the Association is indicated by the publication in this issue of another set of factors relating to cables generally installed under different working conditions. In this case the factors indicate permissible working temperature increases for the various types of cables and conditions, thus increasing the safe loadings. The factors are related to the actual ratings given in the E.R.A. Report F/T128 for copper-conductor lead-sheathed cables, and to both the E.R.A. Report and the factors prepared by the Cable Makers' Association (see *Electrical Review*, 19th February, 1954).

COKE-DUST FIRING

At the official opening recently of the Nechells " B " power station of the Midlands Division of the British Electricity Authority, described in the 14th May issue of the *Electrical Review*, we learnt that the station claims a high rank in the list of stations of the Division on account of its low cost of generation. This has been attained by burning a mixture of coal and coke dust. We do not imagine that there are sufficient supplies of coke dust throughout the country to permit this method of firing in power stations extensively, and no doubt if there were the cost of the fuel would be such as to offset the economies in generation achieved at Nechells. All the same, coke dust should have a good calorific value and the scheme shows excellent local initiative. We have seen this method of firing employed in steelworks which have their own coking plants, and no doubt limited supplies are available from gasworks in certain localities, which could be used for power station firing if the plant could be suitably modified.

COST OF EFFICIENCY

We sometimes hear adverse contrasting criticisms made of the steam power station heat cycle variants, steam reheating and regenerative heating, in respect of capital costs, irrespective of the types of stations in question. This results in a false general picture of the values of the economics of generation. For any one power station there is an optimum figure of thermal efficiency. Higher capital cost affording higher thermal efficiency is obviously more justified in the case of a base load station of given maximum plant capacity than it is in the case of a single- or two-shift station with corresponding plant capacity. It simply means that true economics demands that higher thermal efficiency shall be suitably reflected in commercial efficiency.

GAS-ELECTRICITY COMPETITION

At the recent Advertising Association Conference Sir Harold Smith, chairman of the Gas Council, scouted the idea that competition between gas and electricity industries was a waste of money and that publicity was unnecessary. It is a fact that this competition between two nationalized industries, although deprecated by some " tidy-minded " people, is a safeguard for the public which otherwise would have no protection against monopoly. The aim of the gas industry's publicity, as enunciated by Sir Harold Smith, is to pass on to the public the results of research and development and, by encouraging a fuller use of the industry's products, to keep down the selling prices. This, of course, is also the aim of the electrical industry.

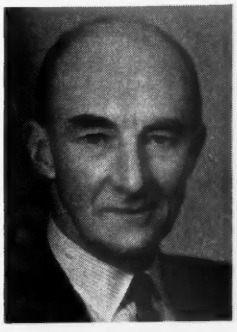
CO-OPERATIVE PUBLICITY

Mr. W. R. T. Skinner, deputy-chairman of the South Eastern Electricity Board, suggested at a recent gathering of manufacturers' representatives that their companies' publicity should not be too narrow. He meant that a firm advertising electric cookers, for instance, should not concentrate entirely on its own products but endeavour to convert the reader to the idea of electric cooking and so with other electrical applications. There is much to be said for this method of approach; it is unlikely that advertisements would lose any of their forcefulness from its adoption. If the " prospect " is made to feel that there is something in electric cooking or water heating or refrigeration, he or she will then naturally become interested in the particular advertiser's equipment. The main thing is to make people electrically minded and business will follow. Mr. Skinner rather paid a tribute to the effectiveness of manufacturers' publicity when he appealed to them to time it so that they were ready to meet the demand which they created. It seems that new models have been advertised before they were available in sufficient quantities, with the result that the Electricity Board has been unable to satisfy inquirers within a reasonable time and business has been lost.

Electrification of British Railways

Can We Afford not to Proceed with It?

By C. M. COCK, M.I.Mech.E., M.I.E.E.



Mr. Cock was chairman of the Committee on the Electrification of Railways appointed by the Railway Executive and the London Transport Executive which reported in 1951. He was president of the Institution of Locomotive Engineers for 1952–53

WHETHER our railways should be electrified is a question which has become hoary with age through a long period of greatly changed conditions, economic and social. The contemporary question is, can we afford *not* to electrify our railways? A considerable amount of electrification has been done; in fact 26 per cent of British Railways passenger train-miles are worked by multiple unit stock, mostly of a suburban character, but the onlymain line electrification with locomotives is the section, Manchester–Sheffield–Wath, where 75 route miles are nearing completion. This was authorized 18 years ago, in 1936, along with the electrification of the Liverpool Street–Shenfield line. Plans have been announced for the extension of electrification from Shenfield to Southend (Victoria) and this will be followed by electrification from Fenchurch Street to Southend, including the Tilbury Branch.

This programme is quite modest in view of the very large field on British Railways where electrification can show a profitable investment. It still follows the uncertain approach to electrification characteristic of the former railway companies, excepting, of course, the Southern. Although the reciprocating steam locomotive has been quoted, in a fuel efficiency sense, as the least efficient machine to survive in a modern age, some 19,000 of them remain the backbone of our national transport system at the expense of 14 million tons of our best coal per annum, polluting the atmosphere and disseminating dirt wherever they may be and imposing general gloom on our railway stations. They are sturdy and reliable, yet their maintenance costs are heavier than their electric counterparts which also have some claims to being more sturdy and more reliable, undoubtedly clean, and also capable of a greater mileage per annum.

In Switzerland and Sweden electricity is the motive power for almost the whole of the railway traffic. The steam locomotive will almost disappear from the Netherlands in the near future. The railways of France are an outstanding example of progressive electrification, and not the least reason for this is a determination to retrieve, by reduction in annual working expenses, the heavy deficits which have to be subsidized by the French Government.

Inflexible Tradition?

Why do we in this country, the traditional home of railways, cling so tenaciously to steam? It may be the tradition itself has become inflexible and stagnant. Perhaps the former railway company boards were nervous of the high capital cost of electrification; and this may still be the deterrent. Or, with so many demands on capital, electrification must take its place in the queue with a large number of equally worthy projects from other industries.

Lord Hurcomb said in his opening address to the convention on electric traction at the I.E.E. in London on 20th May, 1950:—"It is possible that if some of the railway companies had been so courageous and imaginative as to grasp the advantages of electrification in spite of its high capital costs, they would be better off."

All things considered, the high capital cost indeed may be the greatest single factor retarding electrification. Expenditure of capital, however, is a matter of degree. Millions of pounds are being found continually by British industry for expansion of production, but always with a sense that there will be an adequate return on the capital invested, as there must also be to justify electrification. Large-scale electrification in this country would be very expensive. Complete electrification was estimated in 1931 by the Weir Committee to cost £261 million with a return of 6·7 per cent; to-day the cost would be round about £1,000 million but it may be expected that the return on capital would be greater to-day because the savings directly dependent on labour costs would be greater.

Cost of Conversion

It is shown in the Report of the Committee on Railway Electrification (1951), of which the author was chairman, that at least half the lines of this country could be electrified profitably. A very rough approximation of the cost of this for the purpose of argument is £600 million, including signalling. Given say 25 years for construction, the annual spending rate would be £24 million for 280 route miles, equivalent to 700 single-track running miles per annum. This is not an easy target, but this example goes to show that unless the problem is approached with energy and enthusiasm, a generation or more must elapse before electrification can be established on a really effective scale.

Already British Railways spend about £77 million a year for capital purposes and of this about £5 million is spent on steam locomotive replacements. It is evident that only a relatively small increase in total investment is required to allow for the fixed equipment of an electrification scheme (contact lines, substations, etc.) since the £5 million for locomotive replacements could be used for investment in electric rolling stock. It is interesting to note that the proposed annual investment of £24 million is only one per cent of the total gross fixed investment of the United Kingdom for 1953 which was £2,312 million.

But is £24 million per year enough, and can we afford to wait so long for improvement in our rail transport? Various reports suggest that Great Britain will be deficient of 20 million tons of coal annually by 1965 and mounting requirements seem likely to increase that deficiency. Meanwhile our railways must continue to consume some 14 million tons of our best coal yearly. With general electrification the consumption would be reduced to about 5½ million tons, but it would be low grade as used in

central power stations. This would be a substantial contribution towards coal conservation, but completion of electrification of only half our lines by the year 1980 is a too-distant and unsatisfactory target.

Electrification can improve our rail services, both for passenger and goods, for reasons that are well known, and such improvements should bring the railways back to their rightful primary place in the transport system as a whole and restore traffic now being lost to the roads which are congested and overloaded and, in some cases, dangerous. Any policy for improvement in roads cannot be disputed, but surely it must be wrong to assume that the main object of improved roads is to provide for increased road traffic. Improvements are necessary mainly for easier movement of vehicles and to reduce the appalling accident rate.

In view of the proposals of the British Electricity Authority to spend £1,000 million on generating plant during the next ten years, a suggestion that British Railways should spend a mere £24 million a year appears to be paltry. The British Electricity Authority is forced to spend this money not only to keep abreast of the increasing demand for power, but to replace worn equipment and improve the average thermal efficiency of generation which, in 1960, is expected to reach 26 per cent, a commendable advance from the 1952 figure of 21 per cent. The B.E.A. is planning to invest at the rate of some £200 million per annum by 1959–1960 in new power stations and in reinforcing and extending the main transmission lines and distribution network. The capital investment permitted to British Railways which was only £76·6 million for 1952 compares unfavourably with the B.E.A.'s programme. It should also be noted that the magnitude of the two undertakings can be seen from the relative value of their fixed assets in 1952 which were about £840 million for the B.E.A. and £1,467 million for British Railways with gross revenues of £290 million for the former and £620 million for the latter.

Perhaps the urgency of railway improvement may not be thought to be so pressing, but related to the future national coal position there can be no room for complacency. Besides the predicted shortage of coal, it is paradoxical when noting an average thermal efficiency of 26 per cent at electric power stations that steam locomotives should continue to operate at an optimum of 8 per cent, the average being nearer 5 per cent. This, however, is for work done when actually running—much is wasted in preparation, cleaning fires, standing by, etc.

No criticism can be levelled at our nationalized railways regarding the continuous endeavour to provide improved service to the public with the tools to hand. They would, however, be assisted tremendously by electrification. First the railway property could be made and kept clean and attractive in appearance. Faster and more frequent passenger services could be introduced with many inter-city services worked on the interval time system, all of which should result in increased earnings. The amenities of the staff could be improved by clean and pleasant running sheds for locomotive maintenance. Freight train working could also be improved.

There are no technical obstacles to delay a decision on electrification. Three different committees have reported, in 1921, 1927 and in 1951, that 1,500 V d.c. with an overhead contact line is most suitable for general electrification in this country with special provisions for conductor rail at 750 V for the Southern Region; 3,000 V d.c. and high voltage a.c. electrification have not been ruled out for lines of comparatively low traffic density. If, however, this question is to be raised repeatedly in the hope that by some future magical invention a marginal financial advantage might be obtained, a start with electrification on a large scale may never be made at all. "Procrastination is the thief of time."

It is true that electrification of 280 route miles per year is a work of considerable magnitude. There are no reasons to suppose, however, that this target cannot be attained. It would be sensible to settle the priority of the routes to be converted in the light of all the determining factors, and inevitably, the initial rate of construction may be comparatively slow—possibly for the first five years, which should be ample for training additional personnel, and for planning and supervising organizations to be built up in units sufficient to increase the rate of construction to the required extent. At the same time, the already enormous British capacity for production could, if indeed found necessary, be expanded accordingly without detriment to export business. In fact increased production for home electrification would provide a base load which would be of great assistance in export business.

News from South Africa

PROGRESS OF CAPE ELECTRIFICATION

RECENTLY the first electric train travelled over the 20 miles of electrified track from Worcester to De Doorns—part of the main line from Cape Town to Johannesburg—and a daily electric run between these two places has now been started. The first test run between De Doorns and over the Hex River Pass to Touws River is expected to take place by the end of June. A senior official of the South African Railways said that the through service from Cape Town to Touws River would not be economical until the surburban Cape Town–Bellville section had been stepped up from 1,500 to 3,000 V, the new E4 heavy electric locomotives having been designed for a higher voltage than 1,500. Seven of these 155 ton locomotives have so far been allocated to the Western Cape and are being used on the Bellville–Worcester section.

It is expected that the Umgeni power station, Pinetown, near Durban, will soon be commissioned with an initial output of 30 MW. The station will eventually have a rating of 240 MW. This power station is being constructed on conventional lines, except that the exterior is more than usually "streamlined." Most of the exterior walls have been built of golden brown face bricks, with the windows framed in contrasting tones. The asbestos cement troughing used in building the roof is unique in power station construction in South Africa. The smokestack, with a height in excess of 350ft, has an internal diameter of 20ft at the base.

The Electricity Supply Commission's Wilge power station in the Witbank district is being developed in two sections. The first is being equipped with four spreader-stoker type 150,000 lb/hr boilers and two 30 MW turbo-generators. For the second section there will be four 400,000 lb/hr pulverized fuel type boilers and two 60 MW turbo-generators. The power station is being built near the New Largo Colliery and is estimated to cost some £10,800,000. The first section should be completed by the end of this year or early next year.

The Manufacturers' Point of View

How Electrification Would Help the Country and the Electrical Industry

By E. T. HIPPISLEY, M.A., A.M.I.C.E., M.I.Mech.E., M.I.E.E.*
and J. C. WAY, A.M.I.E.E., A.M.I.Loco.E.†

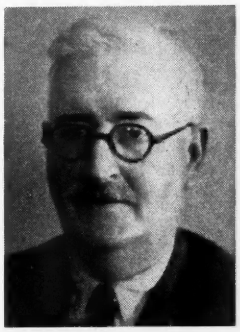
FOR more than half a century, electric traction equipment has formed an important part of the production of the British electrical manufacturing industry and electric railway installations in all parts of the world bear witness to the skill of British engineers. As a result of this long experience, the electrical industry to-day is able to draw upon a wealth of knowledge, both in design and manufacture, of electric traction equipment and is well equipped to deal with the requirements of home and overseas railways.

The first underground railway in the world to be operated by electric power was the City and South London Railway which was opened in 1890, using motors and control gear of British design and manufacture. Other electrifications followed, including the Liverpool Overhead Railway in 1893, the Waterloo and City Railway in 1898 and the Central London Railway in 1900. Thus, by the beginning of the century, there were already four electrified railways operating in Britain, in addition to many electric tramways.

Electrical manufacturers were not slow in showing enterprise, and in placing characteristic faith in the future of railway and tramway electrification in Britain. In fact, it was at this time that one of the largest electrical factories in the country was built and laid out for the prime purpose of building traction equipment. One of its earliest tasks was to manufacture the electrical equipment and plant for the Mersey Railway, the first conversion in Great Britain.

The promise of tramway development was certainly fulfilled and many tramways at home and abroad were installed with British equipment. Progress in railway electrification in Britain was slow, but certain highly successful ventures were made, outstanding examples being the present London Transport system and the electrified portion of the Southern Region of British Railways. The electrical industry has readily been able to meet all requirements of the home railways in addition to a considerable volume of export business.

During the past 40 years Britain has supplied electric traction equipment for railway electrification in many countries overseas including Argentina, Australia, South Africa, the Netherlands, India, Brazil, Spain, New Zealand, Denmark and Poland. The traction equipment installed in these countries alone amounts in all to over $2\frac{1}{2}$ million h.p. of rolling stock, nearly $\frac{3}{4}$ million kW of substation plant and a considerable amount of overhead contact wire construction and electric signalling.



Mr. E. T. Hippisley

Mr. J. C. Way

In addition, during the past 20 years, a large number of diesel-electric locomotives and railcars have been supplied overseas for use on lines which have not a sufficient density of traffic to justify full electrification.

Position in Great Britain

In 1931, a Royal Commission reported on the possibilities of complete railway electrification in this country. At that time the capital cost was estimated at £261 million, spread over 20 years. Against this there was an estimated annual saving of $9\frac{3}{4}$ million tons of coal. It was unfortunate that this report coincided with a national financial crisis, for the mere mention of such a large sum killed the scheme outright. Yet a little more than 10 years later this country was spending £14 million a day on the war effort. Had the report then been implemented, ample labour and much manufacturing capacity would have been available, for unemployment was widespread and order books were empty.

In 1951 the British Transport Commission published a report entitled " Electrification of Railways " which gave the findings of a Committee appointed to investigate the technical and economic aspects of railway electrification. The Committee concluded that at least 4,500 route miles of railway could profitably be electrified.

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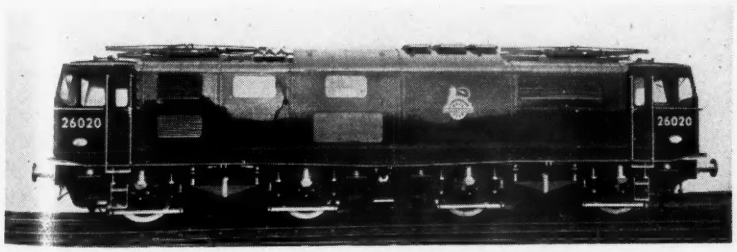
† Manager, Traction Sales Department, Metropolitan-Vickers Electrical Co., Ltd.



British Railways 1,500 V d.c. four-axle electric locomotive for the Manchester–Sheffield electrification

British Railways have long recognized the advantages of electric traction and at the present time, in addition to actual work in progress such as the Manchester–Sheffield main line electrification, they are working on a number of schemes. Plans are well advanced for extending the 660 V d.c. system by some 200 route miles to reach Ramsgate, Dover, Folkestone and Hastings. Simultaneously, the 1,500 V d.c. system based on Liverpool Street is to be extended to Chelmsford and Southend, whilst the electrification of the Fenchurch Street–Tilbury–Southend lines will follow immediately afterwards. All this work is well within the existing manufacturing resources of the country.

Looking further ahead, and bearing in mind the 1951 findings, a picture of far wider scope is presented. Leading authorities and prominent railway officials have again and again drawn attention to the vast harvest of economies to be reaped, with ample return on capital invested, by electrifying the busy main lines of this country. The traffic density over many route miles provides ample financial grounds for electrification, quite apart from the urgent need to increase their carrying capacity. For example, the London Midland Region routes from Euston to the North carry heavy passenger traffic; but it is not always appreciated that the freight traffic on these routes is far heavier and in itself constitutes a basis for electrification.

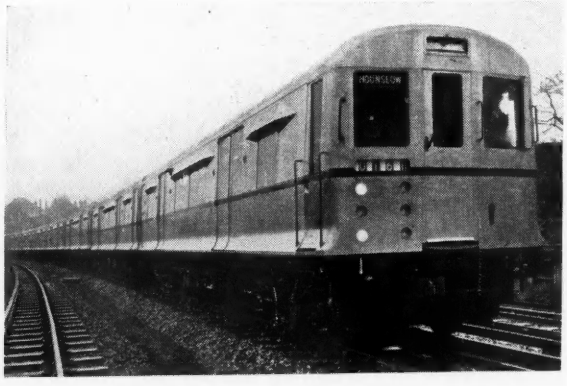
The pattern of traffic over the Euston line is typical of many route miles of main line in this country. Throughout the twenty-four hours there is continuous passenger traffic, whilst at night the preponderant freight traffic is intensified still further. It is worth noting that electrification of such lines could improve the load factor of our power network to an extent even greater than would be obtained by the proposed cross-Channel power link, and that in turn, the tariffs of traction and other consumers might well benefit accordingly.

Whilst transport experts proclaim the operating advantages of electrification, economists point out that rising wages add ever-increasing importance to the case for operating economies. Meanwhile fuel authorities continue to emphasize the vital need of conserving our coal supplies until adequate nuclear power is available. They point to the substantial savings to be obtained through replacing steam locomotives burning 14 million tons of high-grade coal by power stations burning only 5½ million tons of low-grade coal.

Thus a field hitherto recognized merely for its economic opportunity has now developed into a situation of sheer necessity.

Suburban train—Bombay electrified lines, Indian State Railways

Below: London Transport " R " stock



Industry's Plans

Since the war the heavy electrical industry has been rightly concentrating on the manufacture of plant which increases the country's generating capacity. Great efforts have been made both by the electricity authorities and by the manufacturers in reorganizing and expanding their resources. The man-in-the-street has only to remember the days of power cuts and lagging electric clocks to realize how much has been done to abolish power shortages. Although demand is expected to go on increasing, the manufacturers' output has been increased considerably and when the need for generating plant has been met a higher proportion of the country's manufacturing resources could be released for utilization equipment such as locomotive and substation electrical plant.

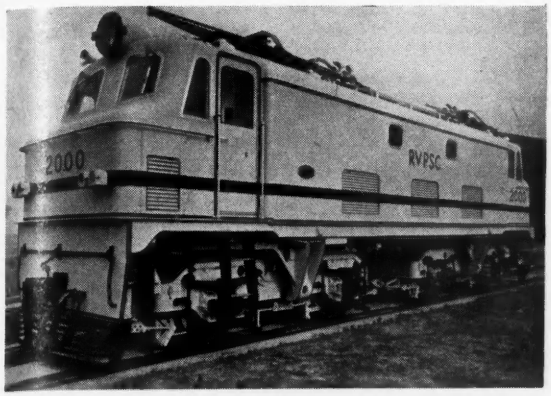
In the event of general railway electrification, British Railways would doubtless convert their existing steam locomotive works for the production of the mechanical parts of electric locomotives and multiple-unit trains, and British manufacturers would be called upon chiefly to supply the electrical rolling-stock equipment. The calculations given in the British Railways 1951 Report indicate the cost of such equipment to be approximately one-sixth of the total electrification cost. Bearing in mind the programme envisaged in that report and its duration, and relating it to the present available manufacturing capacity for electric traction equipment, it appears that it would be possible to meet all home market requirements whilst leaving ample capacity for export business.

Advantages to Industry

In the past, traction business has tended to be spasmodic, and occasional large orders from overseas have brought peaks of great activity with intervening slack periods. This has created many problems in the industry, particularly as the requirements of traction service make it desirable that the electrical equipment should be manufactured in factories specially laid out for the purpose. It has frequently been necessary to provide a basic load of industrial equipment for manufacture in these factories in order to even out the work. Such an industrial load is not particularly suitable, and a regular volume of home traction business would provide a much more satisfactory base load. There would be a consequent useful increase in the manufacturing capacity available for the production of traction equipment.

The value of a substantial home market has been clearly demonstrated in the case of the diesel-electric locomotive industry in the United States, where a large and flourishing business has been built up on the basis of the regular demand from American railroads resulting from their steady modernization policy.

A manufacturing load based on home requirements is

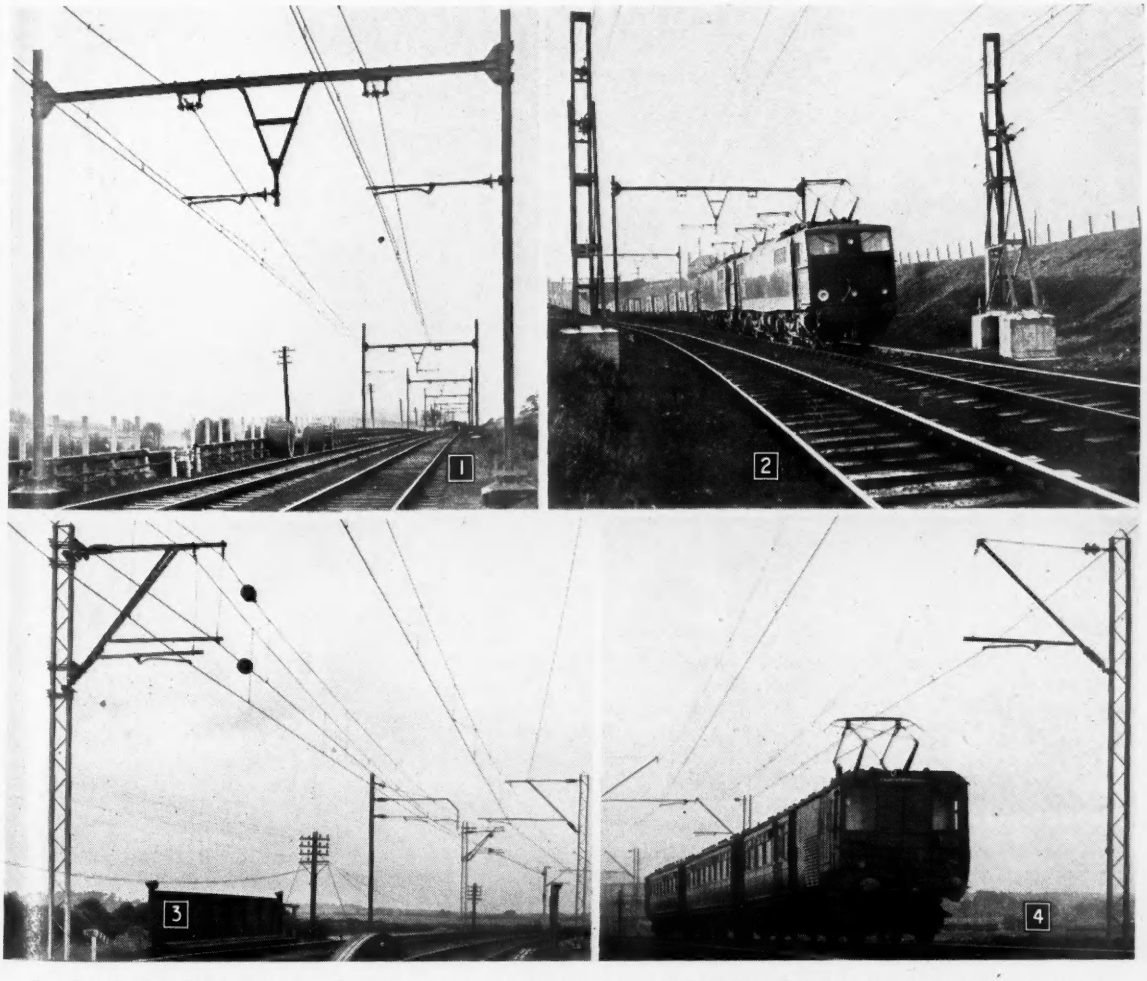


3,000 V d.c. four-axle locomotive for the Parana–Santa Catarina line, Brazil

of value to the industry, not only in helping to maintain economic production in the factories, but in assisting export business in various other ways. It is always an advantage to be able to offer tried equipment and an extensive electrification of British Railways would afford the opportunity to manufacturers of gaining general experience and of being able to demonstrate to visitors from overseas British equipment operating in actual service. Increasing the volume of production, especially if it improved the manufacturing load factor, would bring the further benefit of a reduction in manufacturing costs. This would have its good reflex effect on export business which is meeting increasingly keen competition from Continental manufacturers at the present time.

Conclusion

To sum up, home railway electrification would have beneficial results in several different ways:—British Railways would have modern, efficient equipment which would bring operating economies and more effective utilization of their tracks; the public would be able to enjoy the speed and cleanliness of modern electric stock; the British power supply network would benefit from an improved load factor; fuel consumption per train-mile would be reduced to something of the order of one-third of present consumption, while at the same time use would be made of the small low-quality coal which is much more easily obtained by machine mining; and the electrical industry would benefit from a more stable manufacturing load which, in turn, would assist in obtaining vital export trade.



*Two British electrification schemes.—***1.** *Portal structure on the Manchester–Sheffield line.* **2.** *Double-headed locomotives hauling a Manchester–Sheffield train.* **3.** *Overhead equipment on the Lancaster–Morecambe–Heysham system.* **4.** *One of the Lancaster–Morecambe–Heysham locomotives*

Power for Electrified Railways

Ability of the Supply System to Meet the Demand

By W. B. NODDINGS, M.Eng., M.I.E.E.*

JUST fifty years ago the first considerable length of electrified railway in Great Britain commenced operation on North Tyneside although, a little earlier, short lengths had been commissioned on Merseyside. By this jubilee year of that pioneer work the original eighty miles of electrified track have grown to some 2,400 miles, of which by far the greatest part—namely 2,000 miles—radiates from London, serving the suburbs and the Southern and South Eastern Counties. In those fifty years it has been the dream of electrical engineers and of many railway experts to supersede steam traction.

It can truly be said that the will to electrify Britain's railways has not been obstructed by legislation, by shortage of electricity, by public opinion, or by the inability of the consulting and manufacturing interests to develop the necessary equipment. In particular, Britain's manufacturers have been most enterprising in providing the equipment for overseas schemes, many of which have in fact been planned and developed by British consultants. Parliament has consistently taken a far-sighted policy with regard to the provision of supplies of electricity for haulage and traction. The Electricity (Supply) Act, 1926, provided that the terms of supply for such purposes should be similar to those governing bulk supplies by one authorized electricity supply undertaking to another, which meant that electricity was to be supplied virtually at cost.

These provisions did not, however, recognize the special need for the railways to have the benefit of the diversity between the demands at the different points of supply to a single electrified system—which could traverse the areas of several quite independent supply authorities. To meet this, powers were given in 1935 to the Central Electricity Board to give direct supplies for haulage and traction. In the meantime the Minister of Transport had in 1929 appointed the Weir Committee to examine the economic and other aspects of railway electrification. The Committee reported in 1931 in favour of large-scale electrification, and estimated that a return of about 7 per cent could be shown on a capital expenditure of some £261 million on the necessary track equipment, tractors, etc.

Influence of Traffic Density

To find the reasons why Britain has lagged behind other countries in railway electrification, one must look to the country's traditional conservatism, to its leading place in the development of the steam locomotive, to the abundance of cheap coal in the earlier years, and to the financial difficulties experienced by the railway companies.

Conservatism is always with us but great changes have nevertheless taken place since the war. With the railways under national control, there is now the possibility that broader views may be taken and that plans will perhaps be made for a long-term programme to secure the benefits of electrification. These plans will, however, be influenced by the progress which has been made with diesel traction since the Weir Committee reported. The electrification of branch lines and other lightly loaded lines now seems improbable and a fairly clear division can be seen whereby diesel or diesel-electric traction will take over those lines leaving only the more heavily loaded lines to be electrified.

The Report (1951) of the Committee appointed by the Railway Executive and the London Transport Executive to review various aspects of electrification of British railways indicated that so far as main line, as distinct from suburban, electrification was concerned, the minimum traffic density at which anticipated savings in working expenses would balance the additional fixed charges on electrification appeared to lie between three and four million trailing ton-miles per annum per mile of single-track running line. No similar criterion could be suggested for suburban electrification, the economic justification for which was more influenced by the possibility of a substantial increase in net revenue arising from the improved service. There are some 4,000 route miles with a traffic density of over 4 million trailing ton-miles per annum per mile of single-track running line, 3,000 miles of which have a density of more than 5 million. These lines are indicated in the accompanying map.

Probable Electricity Demand

Even allowing for a substantial increase in the engineering facilities at present available, a programme for the electrification of these lines—about 22 per cent of the total mileage—might extend over a period of 15 to 20 years. Estimates of electricity consumption vary. The Weir Committee took 50 watt-hours (d.c. output from substations) per trailing ton-mile as an average for total electrification. This figure might be rather on the low side for the denser traffic, particularly for suburban traffic with frequent starting and stopping. A reasonable figure might be 60 watt-hours (a.c. input to the substations). The 4,000 route miles referred to comprise 11,500 single-track miles corresponding to about 55,000 million trailing ton-miles per annum and would thus require some 3,300 million kWh per annum with a maximum demand of about 750,000 kW. Such an additional demand arising over, say, 15 years would need the installation of an extra 60,000 kW per annum, a comparatively small amount in relation to the capacity—already of the order of 1½ million kW—added each year to the public electricity supply system.

That the public system could meet this increase in demand is unquestionable and the extra load would be very welcome. The expansion of electricity supply and its economic success has been due to the building up of a balanced load, no application being overlooked. With each phase of expansion has come the opportunity to install larger boiler and generating units; with each increase in unit size has come the possibility of higher temperatures and pressures and greater economy in fuel and other operating expenses. Thus increases in costs have been offset to a considerable extent by economies in operation, so that though the cost of fuel and of plant are now both some four times those ruling in 1931, the price

* Deputy Commercial Manager, British Electricity Authority.

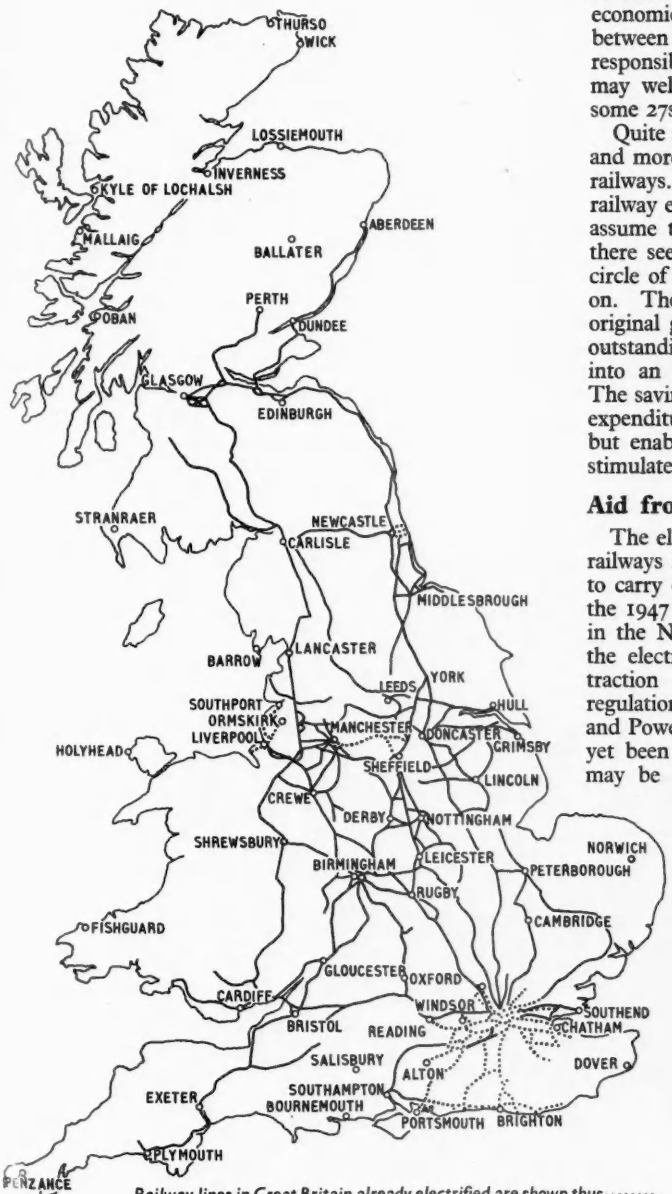
payable for electricity supplies for railway traction, on present-day costs and on a comparable basis to that envisaged by the Weir Committee, would be only about 2½ times the figure taken in its Report.

It is noteworthy that the Weir Committee drew attention to "the very substantial additional saving which would be secured through electrification in the event of any increase in the basic prices of coal." Had major railway electrification been commenced twenty years ago, the savings to the railways to-day would have been far more than any original calculations could have shown. In the meantime, however, capital costs of the necessary equipment have substantially increased and this will tend to offset the additional savings in operating costs now to be expected.

Assuming that electrification would bring its own reward to the railways—which, at least for the more limited scheme above indicated, seems probable—what other advantages would accrue to the country? The saving in fuel consumption is probably the most important. It is well known that electric traction requires approximately only one ton of coal for every three tons used by steam locomotives. Moreover, the coal used for producing electricity is of a low grade, the supply of which is becoming relatively greater, while that for steam locomotives is of the highest grade, which is becoming more scarce. This position is clearly reflected by the need last winter to import over 650,000 tons of large coal at a cost of over £4 million and in the coal price adjustments recently announced by the National Coal Board.

In recent years the dangers inherent in atmospheric pollution have become more fully recognized. The interim report of the Beaver Committee shows that nearly 20 per cent of the smoke and grit nuisance is due to steam locomotives. Recent estimates give the annual economic loss to the country as a result of air pollution as between £100 and £150 million. Whilst the railways' responsibility in this matter cannot really be assessed, it may well be of the order of £20 million, equivalent to some 27s for each ton of coal they burn.

Quite apart from direct economic savings, more pleasant and more speedy travel should bring new revenues to the railways. All the evidence is that increased traffic follows railway electrification and there appears to be no reason to assume that this is only true of suburban traffic. Thus there seems to be an opportunity of breaking the vicious circle of increasing fares leading to reduced traffic and so on. The electricity supply industry itself provides—in the original grid scheme and in the change of frequency—an outstanding example of the benefit of injecting new capital into an industry without a direct increase in capacity. The savings which accrued from what was, in its day, vast expenditure not only covered the capital and other charges but enabled the cost of electricity to be reduced and so stimulated output.



Railway lines in Great Britain already electrified are shown thus·····. Lines with a load of over 4 million trailing ton-miles per mile of single track are indicated thus ———

Aid from the Supply Industry

The electricity supply industry stands ready to help the railways in any electrification plans which they may wish to carry out. Earlier legislation has been consolidated in the 1947 Act by placing on the Central Authority (except in the North of Scotland District) the duty of supplying the electricity required by the railways for haulage and traction on terms and conditions to be prescribed in regulations to be made jointly by the Ministers of Fuel and Power and of Transport. These regulations have not yet been made, but having in mind earlier legislation it may be expected that they will provide for terms and conditions of supply linked directly with those on which supplies are afforded by the Central Authority to the Area Boards, with the railways obtaining the benefit of the diversity between the maximum demands at the several points of supply to each electrified system. The railways will thus be able to make use of the 132 kV grid and, by arrangement between the Authority and the Area Boards, the Boards' lower voltage systems, as may be most convenient and economic. By sharing the use of the public systems with other consumers the railways' distribution costs will be reduced; at the same time other consumers will benefit by the better use made of the systems.

One important matter, however, which the railways will have to keep under review in this joint use is the avoidance of interference with the supplies to other consumers—a matter

on which the Central Authority and Area Boards rightly lay great stress in their arrangements for all types of supplies. Such interference is likely to be caused chiefly by harmonics emanating from rectifier plant, but the use of high voltage single-phase energy for traction supplies might lead to a serious amount of unbalance on the three-phase systems. Difficulties of this nature are best overcome by technical discussion between the railway and the electricity supply staffs.

The great need of the railways for the highest possible degree of security of supply will be dealt with in the same way. Hitherto the reliability of the supply of electricity to the railways has been of the highest quality, and there is no reason to fear that it will deteriorate in any way; in fact, the extension of railway electrification will demand that the electricity system should be extended and reinforced, thus bringing additional security both to the railway supplies and to other consumers.

What effect is large scale electrification likely to have on the load factor of electricity supply? In general, suburban electrification should give some improvement, it being fundamental that the public cannot be using electricity at work or at home at the same time as they are travelling. Thus demand for suburban purposes tends to occur at times different from those for industrial, commercial and domestic purposes. This does not apply to the same extent in the case of main line passenger transport which has considerably different characteristics. On the other hand the main line goods traffic flows more heavily at night and should at least balance the day load of the main line passenger traffic.

It is now the practice of the Central Authority not to charge for any maximum demands at night in excess of the day time demand and there is thus an incentive for the railways to encourage night traffic. It seems that railway supplies could not have a very substantial effect on the national load factor bearing in mind the magnitude of the load in relation to the total system load, which already exceeds 15,000 MW. Nevertheless, some improvement can be foreseen and the load would be welcomed as a means of improving the balance and spreading overheads, leading to cheaper supplies to all consumers.

In reviewing the potentialities of what could not be other than a long-term project, thought must be given to the prospects of nuclear power. Within the space of a few years these prospects have moved from being a hope for the dim and distant future to a probability that in from ten to fifteen years' time quite a substantial proportion of the national electricity requirements may be provided by nuclear plant at a cost not much more than that produced at conventional stations. Such progress suggests that the day when nuclear power can be produced at a cost less than that of coal-produced power may be nearer than one would otherwise hope. A major scheme of electrification started now would not only bring to the railways and to the country the advantages already outlined, but would also enable them to take advantage at the earliest opportunity of the developments in nuclear power. Other countries which have already electrified their railways, or who are actively engaged in doing so, will be able to garner these advantages and so may outstrip Britain which has hitherto been a world leader in the field of transport efficiency.

It may well be said that, even when the most precise figures are available to prove a proposition, it takes an act of faith to put that proposition into practice. In all great industries there comes a time, at their founding and at critical periods in their later life, when an act of faith is essential. It may be that the present critical phase in the life of the railways of this country demands such an act of faith and that comprehensive electrification would lead them to a new era of prosperity and service to the country.

Advantages of Electric Traction

Experience Gained in Actual Operation

By S. W. SMART, C.V.O., O.B.E.*

IN a garden a wheelbarrow is often the best form of transport, so on a railway electric traction is the best means of efficiently and economically operating a train service of an intensive character such as that of the Southern Region of British Railways. The very origin of its electrification demonstrates this.

Years ago, what is now known as the Southern Region of British Railways consisted, in the main, of three principal systems: the South Eastern & Chatham, the London, Brighton & South Coast, and the London & South Western Railways, and as they all lived on the same kind of traffic, that is, the morning and evening business traffic to and from London and the holiday traffic to and from the coast, plus Continental traffic, the rivalry and competition between these companies was extremely acute.

Geographically, the S.E. & C. Railway was best off, with seven London stations well spread over the business areas, especially Charing Cross in the heart of the West End, and Cannon Street on the very threshold of the City. They could thus bring passengers to within walking distance of their offices. The L.B. & S.C. Railway was second best in this respect with terminals at Victoria (West End) and London Bridge (City). The L. & S.W. was the worst off with its terminal at Waterloo, a mile and a half from the Bank, a feature which it rectified to some extent in 1898 by constructing an *electric* tube railway between Waterloo and the City.

In this fight for residential traffic each company knew that its success depended mainly upon the extent to which it could induce the public to reside on its particular railway. The attraction each offered was a fast, frequent and punctual train service to take passengers to the City in the morning and bring them home again in the evening. In short, it was a fight for increasing the residential population

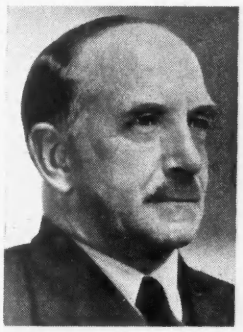
* Superintendent of Operations, Southern Region, British Railways.

of its own territory, to which everything else would be added, goods traffic, coal traffic, shopping, amusement and holiday traffic.

To this end, the L.B. & S.C. Railway, having found that its steam services could not be materially improved or the lines widened in the densely built up London area, decided to electrify its suburban system. A start was made in 1909 and electrification proved so popular and successful that it was pressed on with stage by stage without a break.

The L. & S.W. in self-defence then decided to improve its services and here again electrification was the medium adopted. The S.E. & C.R. also realized that its London terminal advantages would be outweighed by the better electric train services being offered by its two rivals, and so it, too, decided upon an improvement, also by electrification.

When these three railways were grouped under the Railway Act of 1921 competition between them ceased but by this time the benefits of electrification had been so well established and had proved so successful that there was no question of retarding its progress which therefore went on continuously up to the outbreak of the war in 1939. Furthermore, a fast and frequent electric service was proving of the greatest value in meeting ever-growing road competition.



Mr. S. W. Smart

OPERATING BENEFITS

What are the operating benefits that have been derived from the change-over from steam to multiple-unit electric traction? The sum total may be said to be more passenger trains at less cost, and some of the factors that make up this highly satisfactory picture can perhaps best be illustrated by a few practical examples:—

(1) Design of Train Service

The advantages of electrification start right at the planning stage of the service, timings are uniform irrespective of the length of the train, for each unit contains its own quota of power; there are no engine workings to be thought of, and the train is always ready for service without coaling, watering, turning, etc. This freedom from locomotives and locomotive requirements greatly reduces and simplifies the time-table work, and the better speed and mobility of the electric trains changed 11·39 train-miles per steam engine hour into 20·09 miles per electric train hour, a betterment of 76·3 per cent. Empty running is less, because the electric trains complete with their motive power can be berthed at outlying points in perfect readiness for subsequent working. An increase in the peak-hour carrying capacity can be made by increasing the length of trains—this, of course, requires additional stock and might necessitate platforms being lengthened, but it does not affect the time-table.

The following instances will serve to indicate the improvement that electrification has made:—

	Time		
	Steam. Min	*Electric.* Min	*Saving* Per cent
Waterloo and Guildford (via Cobham)	70	51	25·6
London Bridge and Caterham ..	47	35	25·5
London and Hayes	48	37	22·9

Taking the suburban area, as a whole there was during the rush hours an average increase of 69·6 per cent in the frequency of the train service and this increase is attributable to electrification as the peak service had reached its maximum under steam operation; during the slack hours the increase was 148·7 per cent.

(2) Terminal Working

The simplicity of multiple-unit trains revolutionizes terminal working, for no sooner does an electric train arrive than it is ready to depart and this elimination of engine movements enables more revenue-earning passenger trains to be run.

A most important fundamental change took place when the lines to and from Cannon Street and Charing Cross were electrified. Under steam working, the only way the terminals could be kept fluid for the morning and evening business services was by berthing empty trains on the up and down local lines adjacent to those stations. These trains were parked buffer to buffer under the supervision of pilotmen and, as 36 empty trains had to be dealt with in this way every day with an average standing time of 2 hours 6 minutes per train, the working was very expensive in enginemen and guards. Apart from this, the lines being used for stabling the empties were not available for loaded trains. Electrification enabled all this wasteful empty working to be swept away, a great operating and revenue earning improvement. A similar improvement was made on the Tattenham Corner branch on Epsom race days.

(3) Dual Services

The ease and speed with which electric trains can be joined together or divided en route has given many through services that were impracticable under steam working. For example, a train from "A" arrives at the Junction station at 0·0, that from "B" is let on to it by "Calling-on" arm at 0·2 and the two are coupled together and depart at 0·4½; in the reverse direction, the whole train arrives at the splitting station at 0·0, the first portion leaves at 0·1½ and the second at 0·2½. There are 402 dual-route trains of this kind run daily, the bulk over eight routes, and the through working thus so speedily and economically provided under electrification plays a great part in attracting traffic to the railway.

(4) Economy in Stock and Car-miles

Somewhat akin to the foregoing method of working is the speed and economy with which trains can be lengthened or shortened en route. Instead of running a whole train farther than is warranted by the number of passengers, a train starts off, say, with one unit and at the appropriate station en route another unit or units are added, and similarly, detachments are made in the reverse direction. Besides saving car-miles, this practice saves carrying such a heavy book stock, as the strengthening unit used, say, on the inner London part of a journey, can make two such trips compared with the one trip by the unit which does the throughout journey.

Car-miles are also readily saved by running units of two, four or six cars, as required; in short, car-miles can be readily made to fit the traffic requirements. Incidentally, the stock provided for the first stage of the L.B. & S.C. electrification in 1909 is still in use.

(5) Special Traffic

The regular train service being settled, the next consideration is special traffic, i.e., passengers to race meetings,

football and cricket matches, and other events for which something more than or different from the ordinary arrangements are required. But in the first place it is to be noted that a frequent electric service meets most requirements, and if the additional carrying capacity is required in the off-peak period, as is usually the case, the first resort is to increase the number of units on the trains on the routes likely to be affected, thus readily doubling or trebling the carrying capacity of the train without altering the time-table or requiring extra staff.

This facility is of great value, as it is often impracticable beforehand to gauge accurately the number of passengers who will be travelling to some special event; instead of incurring the expense of putting on extra trains which might after all not be wanted, the booked formation of the trains is readily increased by an additional unit or units. This was done, for instance, throughout the suburban area during the period of the Coronation celebrations last year and adequately met the requirements, and it was resorted to again on Saturday last, when the *Britannia* arrived in the Thames with the Royal Family.

Here it may be appropriate to mention that it is a regular practice on busy days in the summer, particularly on Saturdays and Sundays, to use suburban stock and men not required in that area on those days to form relief trains to and from the coastal area that is electrified. Where necessary, such trains are made up of three four-car units, giving a total of 1,158 seats, and are therefore of the greatest value in lifting heavy traffic. The growth of the five-day week lessens the number of suburban trains required on Saturdays, and it is very satisfactory and economical that dual user of such trains and their crews can be obtained by switching them to the coastal services. Indeed, the traffic could not be lifted without them, as there is not sufficient main line electric stock to meet such abnormal demands, notwithstanding that not a single main line unit is kept out of traffic for maintenance purposes at week-ends during the summer months.

This flexibility which electrification gives in catering for special and excursion traffic is further enhanced by the fact that the suburban stock is able to hold its own in running, thus avoiding delay to the main line trains that are being relieved. In the case of steam trains, however, it frequently happens that the secondary engines that have to be used to work relief trains are not really " man enough for the job " and cause a certain amount of delay all round, yet the normal user of such engines on secondary services would not justify their replacement by bigger engines. That is just one of the drawbacks which are experienced with steam traction.

(6) Rapid Acceleration and Track Occupation

Track occupation is at its greatest density between Borough Market Junction and London Bridge where 52 down trains pass over the two down lines in the busiest hour. Of these 52 trains, 28 start from Cannon Street and 24 from Charing Cross and join the common route at Borough Market Junction, where, moreover, the path of the 24 down trains from Charing Cross is crossed on a flat junction by 21 up trains going into Cannon Street. It is therefore very intensive working indeed and in it the rapid acceleration of the electric trains plays the all important part, for the Junction is only a few hundred yards from the stopping or starting points at Waterloo Junction, Cannon Street and London Bridge. The maximum number of steam trains previously dealt with was 39 and this required the expensive berthing arrangements already mentioned. There are now only eight steam trains in the total of 52 and they go to the coastal areas—Ramsgate and Margate, etc.—not yet electrified.

On the question of acceleration it is to be noted that although it would be a convenience if all the up Cannon Street steam trains stopped at London Bridge during the morning business period to enable passengers to change there for Charing Cross, such stops cannot be given as the time taken in re-starting steam trains at London Bridge and regaining speed would wreck the present Junction working and would, in fact, necessitate a serious reduction being made in the train service. And the trains are already heavily overcrowded.

(7) Simplification of Permanent Way

The elimination of engine movements at terminals has enabled the permanent way to be greatly simplified at many places, e.g., at Brighton no fewer than 17 crossover roads and one junction, all essential to steam working, were taken out when the line was electrified, and lesser modifications of this kind have been made at all terminals.

(8) Cleanliness

While it is perhaps not seemingly a matter of much importance, it is known to be a fact that some passengers, especially ladies, have a strong preference for electric trains because they are cleaner, thanks to the absence of soot and smoke. Carriage cleaners have the same preference.

(9) Punctuality and Dependability of Stock

The dependability of the electric service given to the public can be gauged by the excellence of the time-keeping; for example, during the four weeks ended 24th April, 1954, the average late arrival of 114,691 electric trains run on weekdays was 0·61 minute. During this period nearly three million electric train-miles were run and the delays attributable to electrical defects were as follows:—Train defects, 826 minutes or 0·78 per cent of total delay; current supply defects, nil.

The foregoing opinions are based upon the knowledge and experience gained in operating the 1,693 track miles (single) of the Southern Region electrified area. The following data serves to show the magnitude of this task:—

Electric trains run daily	..	5,086
Electric train-miles daily	..	110,655
Electric car-miles daily	..	686,107
Passenger journeys per day	..	1 million (approx.)

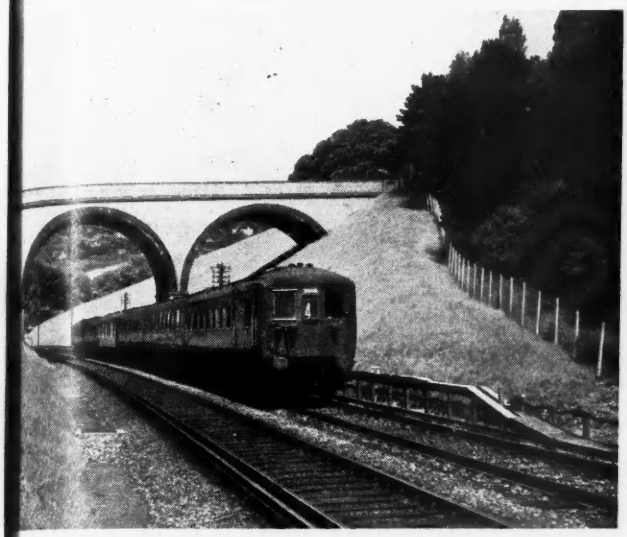
The above figures are based on the winter train services and are, of course, higher during the summer.

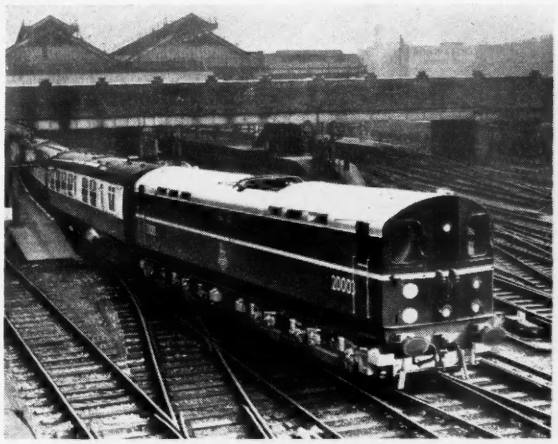
Atomic Energy Instrumentation

DURING the past week British, American and Canadian scientists and engineers have been meeting at the Atomic Energy Research Establishment, Harwell, to discuss instrumentation problems associated with their atomic energy projects. This was the fourth tripartite conference devoted to instrumentation, and the second which has been held in this country. The subjects discussed included the instrumentation and control of nuclear reactors, the use of transistors in nucleonic instruments, radiation dosimetry and the reliability of nucleonic instruments and components. The meetings were held under the chairmanship of Dr. Denis Taylor, of the A.E.R.E., Harwell, and delegates attended from the principal laboratories in the U.S.A., from the laboratories of Atomic Energy of Canada, Ltd., as well as from the principal establishments of the British Department of Atomic Energy. The principal American delegate was Mr. Robert L. Butenhoff, chief of the Radiation Instruments Branch of the Atomic Energy Commission, Washington, and the principal Canadian delegate was Dr. W. B. Lewis, vice-president of Atomic Energy of Canada, Ltd.

British Railways Southern Region

EMBRACING THE WORLD'S LARGEST ELECTRIFIED SUBURBAN SYSTEM





Six-coach express unit for Brighton electrification with Pullman car and (right) 1,470 h.p. electric locomotive hauling the Newhaven boat train from Victoria

THE following is a brief description of the electrified system of the Southern Region of British Railways as it existed at the end of 1953. The power supply system is divided into two more or less self-contained areas imposed by a frequency difference in the incoming supply. The suburban area is fed on a radial feeder system at 25 c/s from two sources. The Western suburban area takes its supply from the Railway's own power station at Durnsford Road, Wimbledon. Originally commissioned in 1915, this has 20 boilers with a total evaporation of 430,000 lb/hr, the total generating plant capacity being 60 MW. Generation is at 11 kV and 17 traction substations are supplied from this source. The Eastern and Central suburban areas are fed from the London Electricity Board's 25 c/s generating station at Deptford through nineteen 0·25 sq in three-core 11 kV cables to (1) a group of three substations—South Bermondsey, Cannon Street and Holborn, and (2) a switch house at Lewisham from which supply is transmitted by 23 feeders to 26 other traction substations.

For greater security of supply the Western and Eastern/Central systems are connected by two sets of interconnector cables—(*a*) between Waterloo and Cannon Street, and (*b*) between Streatham and Wimbledon. In all there is a total of 46 traction substations, all equipped with rotary convertor plant for converting the incoming 11 kV supplies to 660 V d.c. for feeding to the track. The choice of the 25 c/s rotary convertor system was made at a time when the rotary convertor was the most practicable and efficient method of converting a.c. to d.c. for traction purposes, and the use of the lower frequency offered distinct advantages compared with 50 c/s for operation under the overload and short circuit conditions encountered in traction work. All the switchgear is of the indoor type. The whole of the 11 kV system just described will be replaced by a 33 kV 50 c/s system which is now being installed.

For extensions of the electrification scheme to the coast and the outer London areas, the supply is taken at 33 kV 50 c/s from the national grid at eleven points which connect into a system of 33 kV mains supplying the traction substations in the area, all of which are unattended and controlled remotely from control rooms at Three Bridges, Woking, Havant, Swanley and Ore. Solid type paper insulated lead covered cable is used for the transmission system. For the earlier extensions a three-core cable was used, formed of a lead alloy sheath over each separate core, the three cores being afterwards served with hessian tape, lead sheathed and armoured. After 1935 single-core lead sheathed unarmoured cable was used. In general, cable is carried on hooks or in wood troughing on concrete posts along the railway track, special construction being used on bridges, tunnels, buildings and other works where the normal arrangement is impracticable.

Substation Arrangements

The outer area substations are of the single unit type with the h.v. switchgear placed on a concrete raft outside the building. With two exceptions, each substation contains one 2,500 kW continuously rated water-cooled mercury arc rectifier with 12 anodes connected on the double six-phase system. At Fratton substation there are two such rectifiers, while at Purley there are three steel tank air-cooled rectifiers of the pumpless type. The rectifier circuit breakers are of the high speed type and rated at 4,000 A, and they open on reverse current only. The track feeder circuit breakers are also of the high speed type and rated at 2,500 A (continuous) with a rate-of-rise feature. Normally they are set at some 5/6,000 A, but when the rate of current rise is rapid, as under short circuit conditions, they will open at a much lower setting.

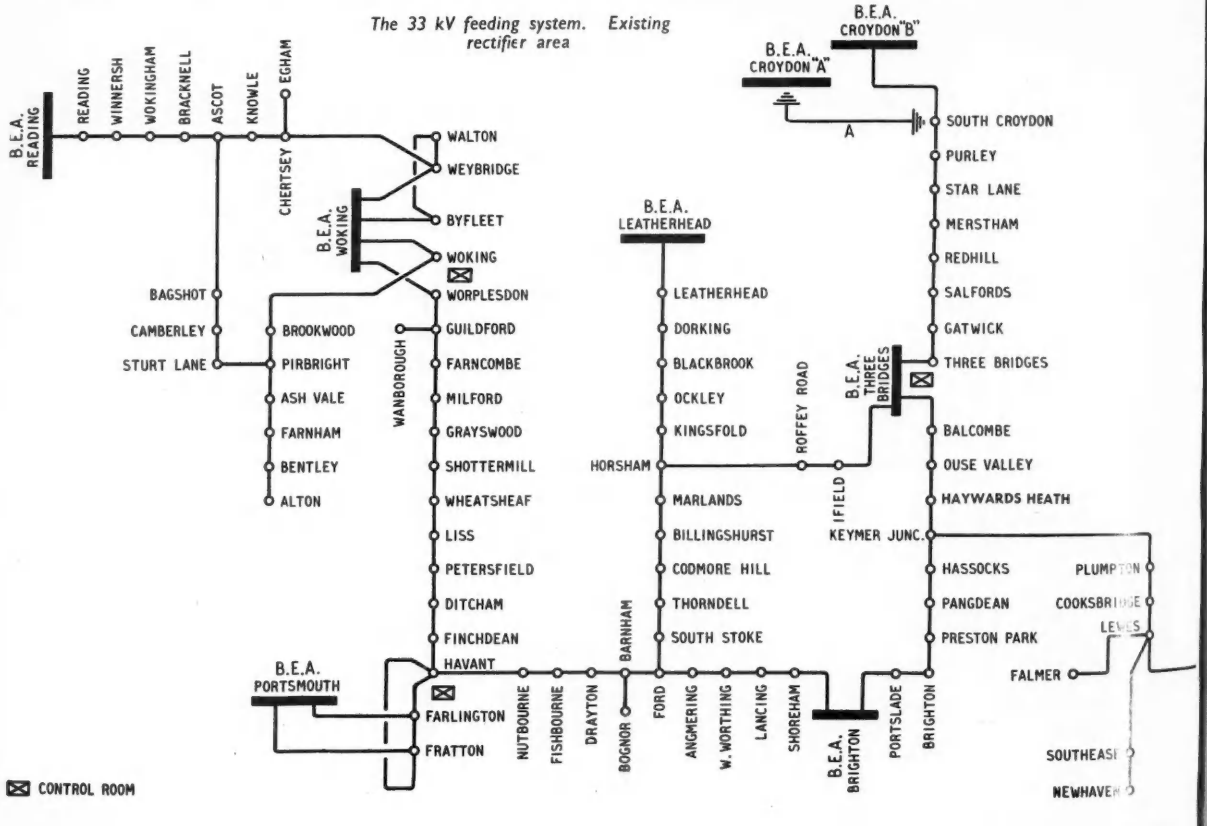
Each control room is provided with a control board bearing a mimic diagram of the system controlled. This is furnished with operating keys, indicating lamps and measuring instruments enabling it to provide the following functions: Operation and indication of a.c. and d.c. circuit breakers, fault alarm indication, remote d.c. metering, indication of a.c. feeder synchronism, check testing, and telephone communication between all points controlled.

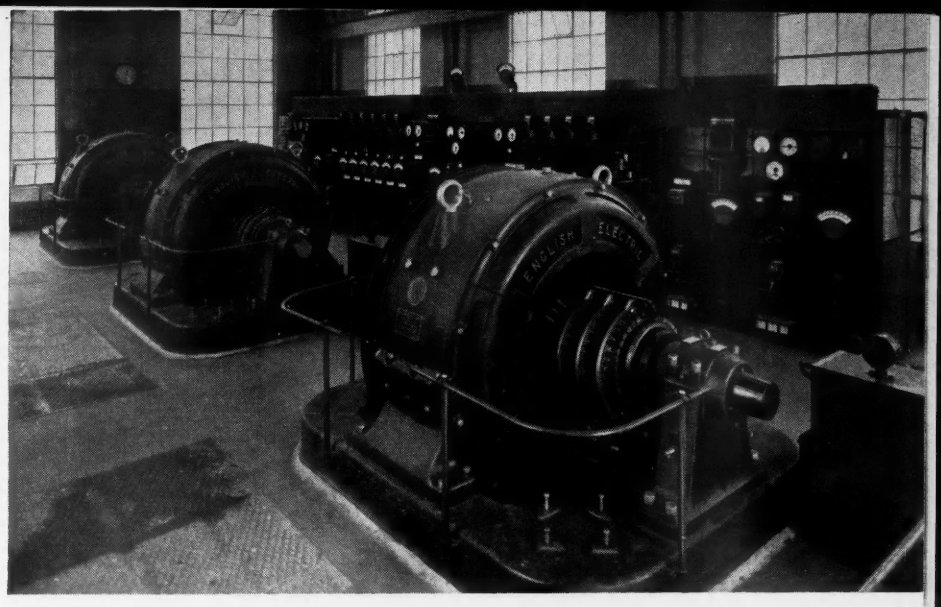
The supervisory control arrangement is of the d.c. low voltage polarized selector type with simple impulse transmission over multicore pilot cables laid between the control room and its related substations. The control panels are arranged around a central desk accommodating the supervisory telephone exchange, alarm bells and fault relays, from which the operator can keep a general check.

In general the conductor rails are fed through 1·0 sq in rubber insulated and bitumen covered cables laid in 5in by 5in wooden trunking. Electrical continuity at rail joints is maintained by means of four 0·42 sq in ribbon type copper bonds. The rail ends are ramped at a normal slope of 1 in 48 for facing ramps and 1 in 36 for trailing ramps. Track sectioning is effected by means of pole-operated hook switches.

The running rails which form the return circuit are normally bonded at the joints with two 0·166 sq in copper bonds (one bond gas-welded to the rail head and one protected pin-type bond under the fishplate). Cross bonds of 0·15 sq in section are provided between the single rails of each track and between parallel tracks to equalize the

The 33 kV feeding system. Existing rectifier area



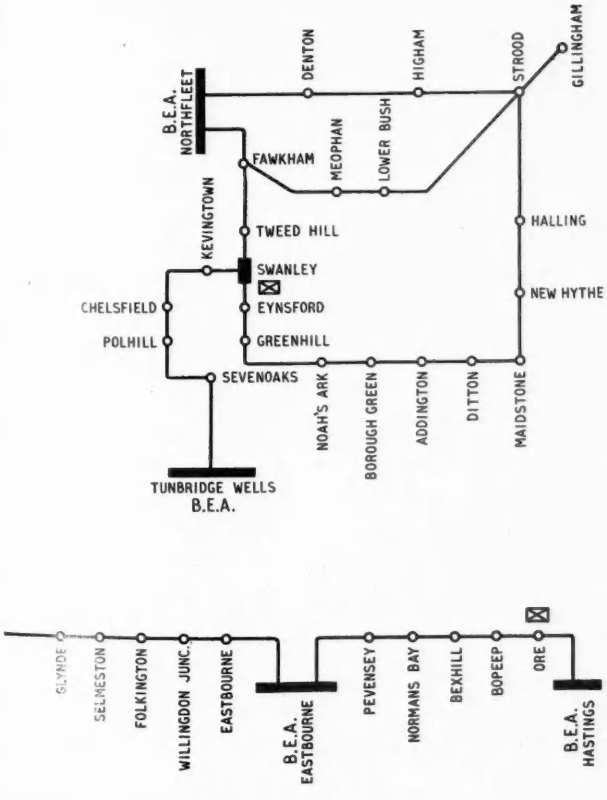


Interior of Havant control room is shown on the left. Mimic busbar system indicates h.v. feeding system at top of panels, rectifiers in middle, and track feeder circuit breakers and tracks at the bottom of the control boards

On the right is the interior of a typical rotary convertor substation

current in the rails and to assist in minimizing the voltage drop. These bonds are spaced at intervals along the track ranging from 150ft to 1,000ft according to the distance between stations. In some of the earlier suburban area installations the return circuit had to be reinforced permanently with an additional rail laid between the running rails and cross-bonded to them.

Where the track is used for signalling track circuits, insulated rail joints must be used to separate the various track sections, and to form a path for the traction current across these joints impedance bonds are provided. As the intertrack bonding is required at not fewer than four positions per mile, if there are no conveniently placed impedance bonds, resonating bonds are used to provide the necessary points of attachment between one track and another.



Supplies for signalling and other railway purposes are distributed in the London area at 3,300 V single-phase at two frequencies: 75 c/s obtained from 25/75 c/s frequency changers, and 50 c/s from local Electricity Board systems. Feeds are also taken at 440 V 25 c/s direct from certain substations.

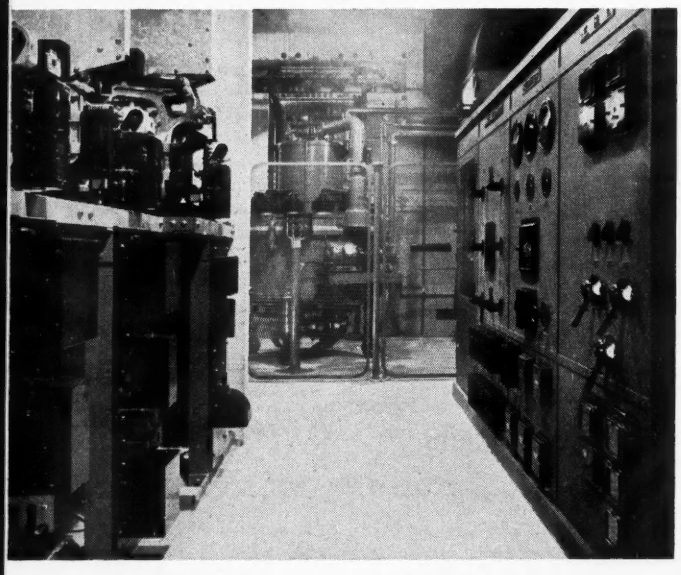
Suburban Rolling Stock

The great majority of the Southern Region passenger services are worked by multiple unit trains of which there are two main types: Suburban stock for working the inner London area and for providing stopping services on the main lines, and express stock for the main line fast services. The standard length of unit for the suburban stock is four coaches consisting of two motor coaches between which are coupled two trailers, though a considerable number of two-coach units (motor coach and driving trailer coach) have been built for working the outer suburban services. Before 1936 the motor coach control equipments were of the electro-magnetic type but since then electro-pneumatic control gear has been universally used. Totally enclosed traction motors were employed up to 1939, but since the war coach-ventilated motors have become standard.

Each motor coach is provided with two traction motors mounted in the leading bogie with an hourly rating of 180 h.p. These are controlled on the usual series-parallel system with automatic control of accelerating current. All circuits, including lighting and heating, are fed at line voltage, but the actual control supply to the electro-pneumatic power contactors is at 70 V which is provided by a potentiometer.

Each motor bogie is equipped with a collector shoe on each side, and all the collector shoes on a four-car unit are connected together by bus lines which run the full length of the train. Shoe fuses are at present used, but it is hoped that when all the track feeder circuit breakers are of the high speed type it may be possible to dispense with these.

Since 1951 the control equipment has been entirely re-designed. Lighting and control circuits are now fed from a motor-generator set carried on each motor coach. The cab layout has been remodelled; a master controller in which is incorporated the main control switch is housed in a flat top desk with a fascia under the driver's lookout carrying the various instruments and gauges. All the auxiliary control equipment for both the motor coach and its adjacent trailer coach is mounted in a steel cupboard in the cab, and the whole four-coach unit may be switched in ready for service by the simple movement of one handle



Rectifier substation for Maidstone and Gillingham extension. Rectifier compound at back, d.c. track feeder circuit breakers on left, control panels on right

on the side of each cupboard. Both passengers' and driver's comfort has been studied in the design of the stock. The main particulars of the new 1951 type stock are given in Table I; corresponding figures for the pre-1951 stock and for express stock are shown for comparison.

It will be seen that in the design of these units an opportunity has been taken to increase the acceleration and also the balancing speed on the level, so that some margin of performance is also provided for possible future needs.

Table I.—Particulars of Express and Suburban Rolling Stock

		Type of Unit		
		Express stock	Pre-1951 Suburban	1951 type Suburban
Weight of four-coach unit (empty)	tons	158	134	137
No. of motors		4	4	4
Normal average accelerating current per motor	amps.	310	410	440*
Rate of acceleration	m.p.h.p.s.	0·5	0·8	1·1
Balancing speed	m.p.h.	64·5	55	62
1 hr motor rating at 600 V, for 75 deg C temperature rise	h.p.	225	180	235
Maximum service speed	m.p.h.	75	65	75
Motor gear ratio		2·48 : 1	3·82 : 1	4·06 : 1

* Driver has a choice of a lower acceleration at 375 A under slippery rail conditions.

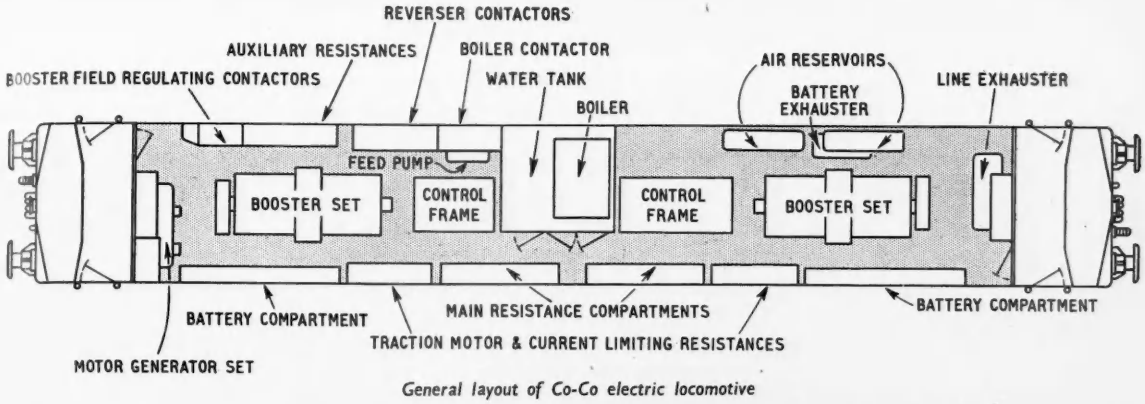
The earlier express units provided for the Brighton and Eastbourne extensions in 1932–5 were composed of six-coach units with a motor coach at each end. Each motor coach was provided with four 225 h.p. (hourly rated) totally enclosed traction motors, the two motors on each bogie being permanently connected in parallel and the two groups so formed being then controlled on the usual series-parallel system. The power contactors are electro-pneumatically controlled, and all control and lighting circuits are fed at 70 V from motor-generator sets on each motor coach. Collector gear is fitted on each side of each motor bogie and all shoes are connected to a common train line through shoe fuses as on suburban stock.

A Pullman car is included in 23 of these six-coach units and the remaining 17 have a buffet car for light refreshments. The maximum length of train is two six-coach units; vestibule connection is provided between the coaches of a unit, but there is no vestibule connection between units. Three five-coach all-Pullman units were also built in 1932 for working the "Brighton Belle" services. For the Portsmouth extensions in 1937–8 a total of 87 four-car units were built. These consisted of two motor coaches with two trailer coaches coupled between them. Each motor coach has two 225 h.p. (hourly rated) totally enclosed motors with electro-pneumatic contactors and control gear, and with motor-generator-fed l.v. circuits similar to those for the later suburban stock. Sixteen of these four-car units have a restaurant car, 13 have a buffet car, and the trains are made up of four, eight or twelve coaches as required by the traffic, vestibule connection being provided throughout the train.

All trains have the Westinghouse automatic brake throughout with a pressure of 100 lb/sq in in the main reservoir and 70 lb/sq in in the train pipe, supplied from an electrically driven air compressor mounted under each motor coach with an output of 19·5 cu ft of free air per minute. The stock built from 1951 onwards has the electro-pneumatic brake, in which air is directly admitted to the brake cylinder on each coach by means of electro-pneumatic valves operated from contacts on the driver's brake valve. By this means the brake application is made simultaneously on each coach of a train, and this feature, coupled with the facility for graduating release, enables smoother and more accurate braking to be achieved.

With an eye to the eventual electrification of all its main lines, the former Southern Railway constructed three mixed traffic Co-Co type electric locomotives for experimental purposes, and these are now used for working the Newhaven boat train and selected freight services. They

Conductor rail sectioning hook-switch in open position and (right) double rail track circuit with impedance bonds and cross bonding



General layout of Co-Co electric locomotive

embody special features to enable them to operate on a conductor rail system without losing tractive effort when passing over the inevitable gaps in the third rail. After examination of various possible solutions to this problem a design was finally adopted whereby the traction motors were supplied continuously through two motor-generator sets mounted in the body of the locomotive, the motors of each set being supplied from the third rail. Between the motor and generator a one ton flywheel is mounted, the stored energy of which is used to drive the set when contact is lost from the conductor rail and thus supply the traction motors for a short period.

Each motor-generator set is connected to three forced-ventilated traction motors on one bogie, and the two bogies are thus supplied quite independently of each other. The generators of the sets are separately excited, and when first starting the locomotive each set is excited so that its e.m.f. opposes the line voltage, after which the excitation is gradually reduced until full line voltage is supplied to the three traction motors in series. The generator excitation is then reversed and the voltage built up in series with the line voltage until the three traction motors are working in series on 1,200 V, i.e. at their rated voltage of 400. The circuit is, however, so designed that no part of it is at any time at a potential greater than 660 V to earth. When contact is lost with the conductor rail in gaps, the sets continue to run on flywheel energy; the shunt connected motors become generators and feed the line portion of the circuit, and sufficient tractive effort is maintained on the locomotive to enable it to cross the longest gap likely to be encountered. The whole process is automatic and requires no special action on the part of the driver.

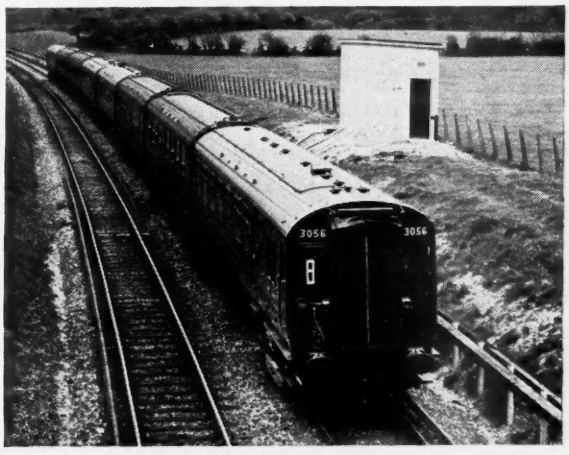
Table II.—Leading Particulars of Electric Locomotives

Total weight	101/105 tons
Total horsepower (6 motors)	1,470 h.p. (1 hour)
Normal average accelerating current, per motor	800 amperes
Acceleration with 425 ton passenger train	0·5 m.p.h.p.s.
Acceleration with 1,000 ton freight train	0·3 m.p.h.p.s.
Balancing speed with 425 ton train	65 m.p.h
Motor rating for 75 deg C temperature rise	245 h.p. (1 hour)
Maximum service speed	75 m.p.h.
Gear ratio	3·83 : 1

These locomotives have proved entirely satisfactory in service. The motor generator control avoids power resistance losses at starting and gives greater flexibility in driving, since every notch is a running notch. With the heavy track occupation of the Southern Region this feature is especially valuable. Table II gives the principal particulars of the locomotives.

Auxiliary circuits and main generator excitation are fed from a 9 kW 150 V motor-generator set, which also charges the 120 V 70 Ah alkaline battery. Air for braking and control purposes is furnished by two compressors each delivering 19·5 cu ft of air per minute. The locomotive has compressed air brakes, normally controlled from a self-lapping straight air brake valve at each driving position. For operating the vacuum brakes of passenger and van trains a vacuum brake valve is also provided, and when this is being used the locomotive compressed air brakes are controlled in synchronism through a proportional valve.

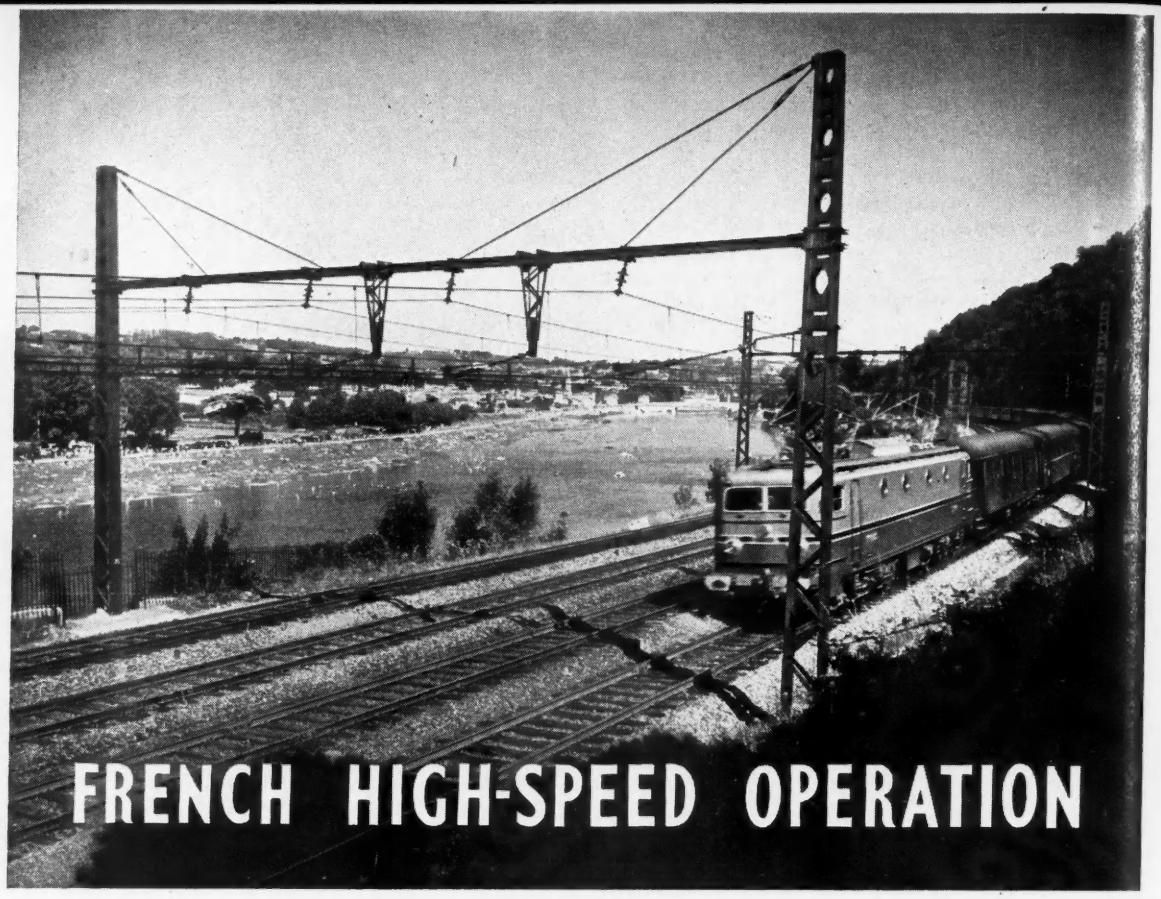
Vacuum braking power is supplied from two rotary exhausters, and to avoid application of the vacuum brakes when the locomotive is traversing long gaps in the conductor rail, when power would normally be lost from the shoes, the circuit is so arranged that under gap conditions the exhausters take their power from the booster motors which are then acting as generators.



Two four-coach express units for Portsmouth extension

I.E.E. SOUTHERN CENTRE

THE summer meeting of the Southern Centre of the Institution of Electrical Engineers will be held at Reading on 11th June and will include a visit to Huntley & Palmer. Arrangements have been made to convey members by coach from Brighton, Portsmouth and Southampton. Lunch will be served at the Grosvenor Hotel, Caversham. The charges for members and guests will be 21s and for students and guests 15s. Those wishing to join the Brighton party should apply to Mr. R. Summarsell, Mid Sussex House, South Eastern Electricity Board, North Road, Brighton, 1, and those for the Portsmouth and Southampton parties to Mr. C. G. Brammer, Southern Electricity Board, Magdalen Road, North End, Portsmouth. Applications should be made by 5th June.



FRENCH HIGH-SPEED OPERATION

Paris–Lyons Electrification Scheme

THE recent achievements of the French National Railways in high-speed working have focused engineering attention particularly on the design of the substations, track equipment, signalling gear and locomotives employed on the Paris–Lyons route of the electrified network in France.

Electricity is taken from the terminals of a number of large transformer substations belonging to the general very high voltage network of Electricité de France. Between these supply points, the French National Railways have constructed two distribution feeders, operating at 60 kV, to which are connected the traction substations placed along the length of the track. The two three-phase 60 kV lines, strung on independent towers which are normally spaced at about 30 metres, have to follow a somewhat irregular route.

The lines are made up of steel-cored aluminium conductor each with 30 aluminium strands and seven steel strands, with a total cross sectional area of 228 mm^2. The conductors are arranged in triangular formation, the spacing between them being 4·5 m, and a steel-cored aluminium earth wire is strung above the conductors. The towers, which are 24·5 m high along the general run of the route, and are of normal standard design, have been arranged in such a way as to reduce to the greatest possible degree the volume of concrete required for the foundations.

On the line towers systematic use has been made of a new type of clamp with a deformable element which, if a conductor breaks, will absorb a considerable proportion of the energy released.

Heavy traffic peaks of up to eighteen trains an hour at one point and thirty trains on both tracks in the two most heavily loaded hours are experienced, these trains being of 750 tons weight and normally running at 105–110 km/hr. This has necessitated the spacing of the track substations as closely as 14 km. Generally each substation is equipped with two 4,000 kW traction supply groups, but from Dijon to Lyons where the substations are spaced at only 8 km they are each equipped with only one 4,000 kW group.

During lightly loaded periods one of the two traction supply units is sufficient, but at times of heavy traffic both are required and the substation does not then possess any standing reserve. However, the three substations situated near Blaisy-Bas, in the section with a gradient of 8 mm/m, which is the most difficult part of the line, are each provided with a third unit as a stand-by, and this also applies to the substation at Dijon-Perrigny. In the Paris–Lyons route there are 51 substations all told.

Each traction substation, where the incoming supply is 60 kV three-phase and the output is 1,500 V d.c., consists essentially of three parts:—(*a*) an outdoor h.v. substation so arranged that the main substation busbars may be connected to one or other of the three phase lines by means of section isolators; (*b*) the traction supply units which incorporate the transformers; and (*c*) a 1,500 V busbar system serving the traction supply units through circuit breakers and feeding the catenary lines of the different tracks above and below the substation.

The four incoming feeders (two from the Paris side and two from the Lyons side) terminate on the bays of a

Our title picture shows that on four-track sections catenaries are supported by stayed metal gantries crossing all four tracks

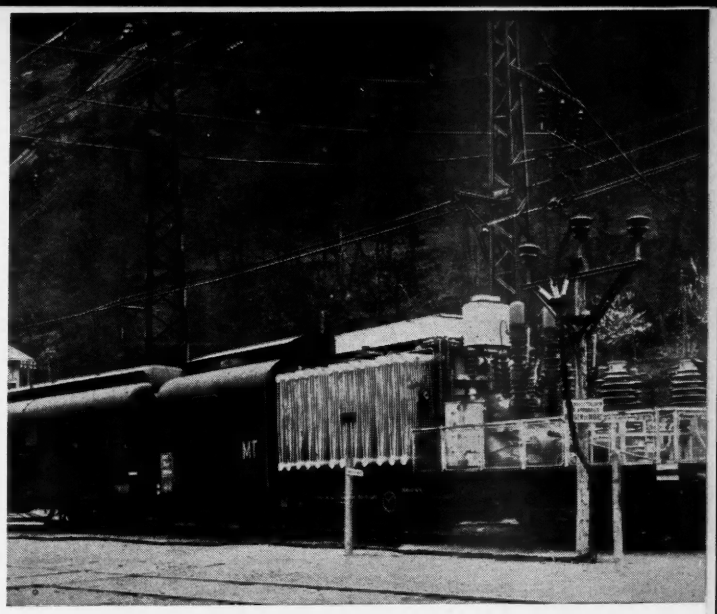
central gantry of construction generally similar to that of the line towers and running parallel to the main centre line of the substation. On each side are situated two parallel sets of busbars. One of the lines is connected to the busbar on the track side, and the other to that on the opposite side, by means of section isolators of the Merlin-Gérin type, made by the Etablissements Merlin-Gérin and the Société Gardy. In certain section substations the two lines are connected to the same busbar through h.v. circuit breakers.

To one of the longitudinal busbars there is connected, by means of section isolators, a set of transverse busbars, which feed two 60 kV/200 V transformers provided for the supply of energy to the auxiliary services of the substation, the automatic block signalling equipment, and the auxiliary equipment on the main transformers which form part of the traction supply units. The outdoor substation is raised by 60 cm above the service track in that part occupied by the heavy plant, and the main and auxiliary transformers are mounted on rollers. This arrangement allows for these plant items to be rolled directly on to the platform of a truck, in case of need, without the use of any special lifting equipment.

The traction supply units are made up of transformer and mercury arc rectifier assemblies, the nominal ratings of which have been increased from 2,000 or 2,750 kW to 4,000 kW. Before ordering a series of equipments of this rating, the French National Railways engineers had arranged for the construction of prototypes mounted on trucks to facilitate their use in preliminary experiments; these have since served as mobile reserves.

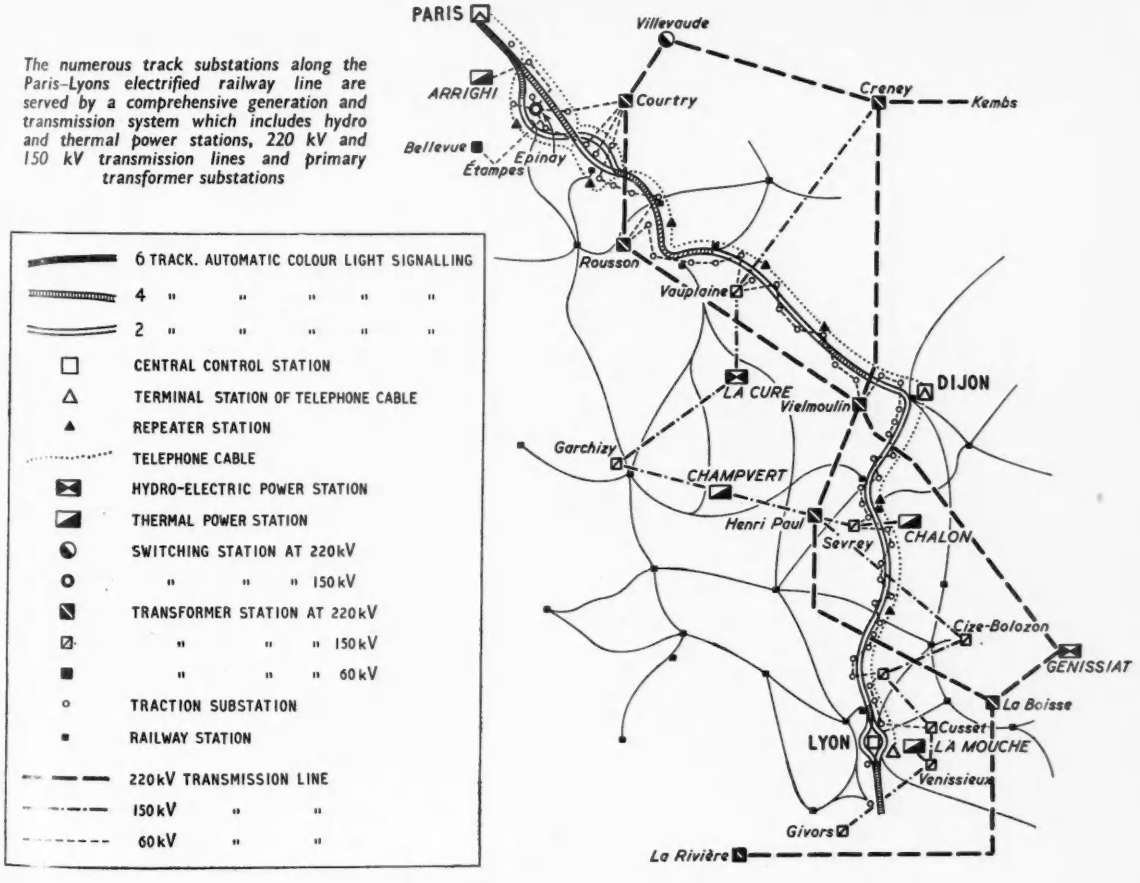
The equipments, supplied by the Compagnie Electro-Mécanique and Alsthom, are of the six-phase type with 18 anodes, and with water cooled tanks. In the rectifier cubicle is closed circuit equipment which incorporates water cooling of the air. The rectifier units are also mounted on rollers, and they can be drawn out to a corridor for accessibility.

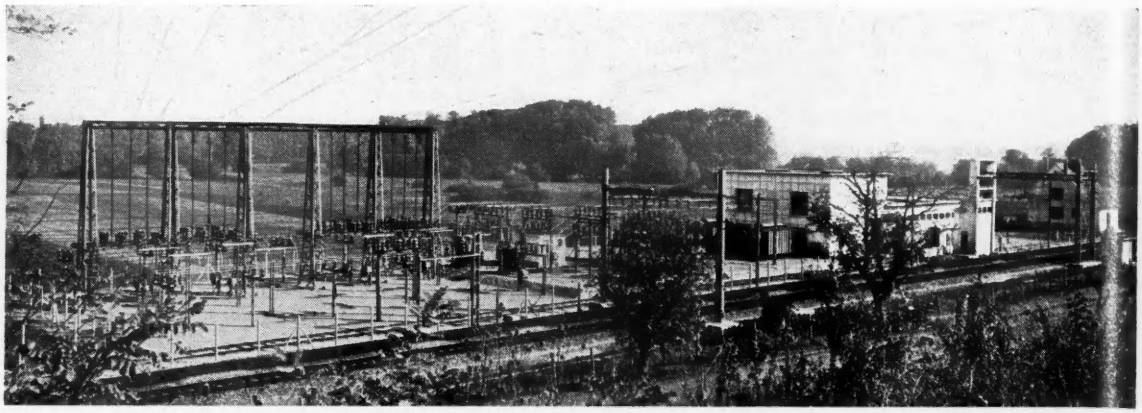
Normally the traction substations are remotely controlled from central substations, this system of control being more economic and more technically perfect than local control



Mobile 4,000 kW rectifier-transformer traction supply unit

The numerous track substations along the Paris–Lyons electrified railway line are served by a comprehensive generation and transmission system which includes hydro and thermal power stations, 220 kV and 150 kV transmission lines and primary transformer substations





Each traction substation consists essentially of three parts: Flogny substation, 115 miles from Paris

or the manning of all the substations. The 51 traction substations are arranged in three area groups, each group being controlled from its particular central control station—Paris, Dijon or Lyons.

The substation controller operates in an office which has telephone communications with all the services with which the controller needs to maintain contact, e.g., power stations, substations, maintenance workshops and the Electricité de France system control. The control operations, as such, are carried out from a semi-circular control board, of which the central office occupies the middle portion, and where automatic indications are provided of the operation of all the plant in the substations. The switchboard also includes ammeters giving a continuous indication of the current output of each traction supply unit. The main switchboard thus includes a panel for each substation control, and the substation switchboards are presented in miniature to the control engineer. The control engineer operates on each panel just as if he was operating on the panel in the corresponding substation, and all operations are carried out as if he was in effect simultaneously working in all the substations, the control of each substation being independent of that of the others. All this is brought about by an automatic telephone type system in which current impulses direct the control to the particular equipments required to be operated.

Two telephone "quads" (each of four pairs of conductors) are all that are required for the operation of the whole of the substations, use being made of currents at harmonic frequencies for different operations on the same circuits. The system was installed by the Compagnie Générale de Construction Téléphoniques.

Direct current at 1,500 V from the substations is distributed to the electric locomotives by means of overhead contact lines, with rail return. The overhead lines are fed from a distribution cubicle incorporated in one of the supports of the reinforced concrete gantry used for the outgoing feeder connections.

On the tracks on which high-speed trains operate it is essential that the contact wires should be parallel to the level of the running track, that they should have sufficient mechanical tension whatever the ambient temperature, and that they should present a certain amount of flexibility to the passage of the pantograph collector. These requirements led the designers to use an overhead line with compensated catenary suspension, which includes essentially the following components: A main carrier wire of bronze of 116 mm² section suspended by insulators from poles or gantries along the track; an auxiliary carrier wire of copper of 143 mm² section, suspended from the main carrier wire by hangers of variable length in such a way that it remains parallel to the level of the track; and two contact wires in copper of 150 mm² section, placed side by side and suspended from the auxiliary carrier wire by copper hangers (riders) of fixed length. The contact wires are grooved; grips carried by the hangers hold the wires by means of these grooves, in such a way that the lower surface of the wires is absolutely smooth.

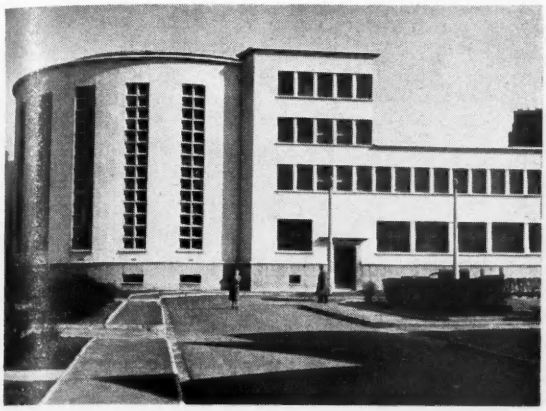
In zones where the traffic density and line gradients may call for heavy currents, the catenary installations are completed by feeders in the form of copper conductors of 147 mm² or 262 mm² section, which are supported from the same insulators as the main carrier wire. To ensure the correct position in plan of the catenary and to prevent it swinging, the auxiliary carrier wire is provided at each support with an anti-swinging device (the attachment to the carrier wire is made through an insulator), and at curves the contact wires are held by insulated arms fixed on the anti-swinging device. The problem of electrical continuity has been solved by dividing the catenary into electrical sections with a 40 cm air break between them. These sections may be bridged by means of section isolators designed for manual operation.

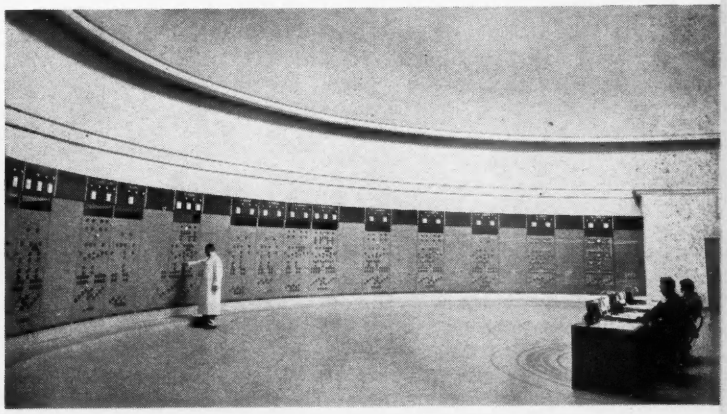
The contact lines for the secondary tracks are provided only with the main carrier wire and the contact wire. The contact wire on tracks on which only low speed traffic runs, are of the single suspension type, i.e., they are made up of a single contact wire suspended at each support from an insulator of the cap and cone type.

On four-track sections the catenaries are supported by stayed metal gantries crossing all four tracks. Their foundations are, in general, made up of steel profile sections assembled according to a small number of different arrangements, in order to simplify the equipment and to lower construction costs. These gantries present a silhouette which is agreeable to the view, and at the same time do not obstruct the drivers' view of the signals. Some of the gantries support the actual signals, in which cases they are more massive and are not stayed.

On the double track sections pole and bracket suspension is used independently for each track. Metal masts are used on about half the routes and on the remainder pre-stressed reinforced concrete poles have been employed.

Telephones are employed for the following special purposes:—The regulation of traffic which allows an operator at a central control point to control the running of trains in a particular section of the line by receiving information





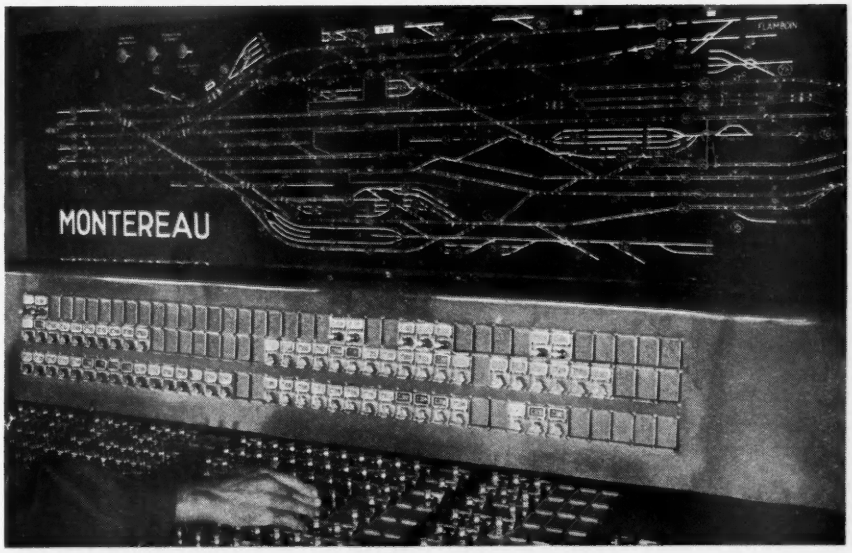
Each group of traction substations is operated from a central control station: the one near the Gare de Lyon in Paris is illustrated

from local stations and then by giving orders to them; communication with the control rooms which decide on the running or non-running of trains, and the distribution of all kinds of plant and equipment, and with the information centres which deal with all information relating to the operation of the trains; and for the operation of the traction substations on electrified lines. Only very limited telephone facilities were at first available and the lines generally were in a very bad condition.

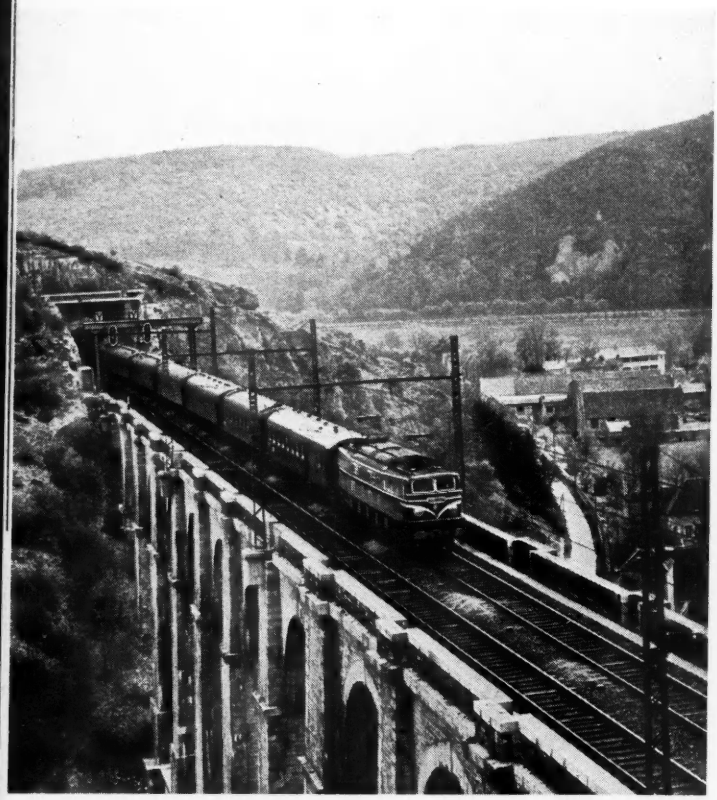
On electrification the problems presented by the outworn telephone system were solved by placing the circuits underground in co-operation with the French Post Office.

The joint cables for the long-distance circuits are loaded and ten repeater stations are distributed along the line at regular intervals to amplify the telephone transmissions on these circuits and to remedy the attenuation due to the length of the cables. The connecting of the cables constituted a very delicate operation which necessitated the formation of a number of teams of highly specialized workers, and this also applied in the case of adjustment and measuring operations. The increase in the number of circuits brought in its train a development of the local telephone installations which include: The installation of automatic telephone exchanges and new manual exchanges at Paris, Dijon and Lyons; the replacement and extension of the equipment at large exchanges; the equipment of small stations with specially designed telephone apparatus; the installation all along the route of weatherproof telephone equipment to provide channels of communication with signal boxes, with the central regulator and with the main substation control centre (alarm circuit).

The Paris–Lyons line has certain special characteristics which justify a particularly complete signalling installation. Previously, a considerable length of this line was equipped with mechanical signalling planned according to methods which were already old-fashioned, and most of the equipment was at least 50 years old. Stage by stage there had been added additional equipment necessitated for safety reasons, but still militating against the use of the full capacity of the line. Only the Paris–Melun, Montereau–Sens, and Les Laumes–Blaisy sections, equipped in 1938 with luminous automatic block instruments, and the station at Dijon which was provided in 1939 with an electrical signal box with routing levers and another in course of installation, had been equipped with modern plant. In addition, there were the problems raised by the fact that two sections, St. Florentin–Les Laumes and Blaisy–Dijon are of double track only, which constitutes a serious bottle-neck for the traffic, on a line which from Paris to St. Florentin is quadrupled and spreads out from Dijon in many directions.



This new signal box at Montereau replaces five manual boxes and the control desk incorporates 306 miniature push-button switches



The line between Blaisy and Dijon is equipped for two-way reversible working; note colour light signals facing same direction

The first improvement consisted of the installation of luminous automatic block equipment: the block sections so brought into service were very much shorter than those applicable to the manual block system, and the regulation of the traffic was made much simpler, and thus its flow was accelerated. Signals which were illuminated by day and by night and the block system itself increased the safety of operation. The installation of automatic block working brought with it the disappearance of all the small switching frames along the track and those installed in the stations.

To replace the signal boxes destroyed by the Germans, electric signalling frames of the most modern types have been installed at the following centres:—At Dijon, two boxes of a new standard type with route levers with mechanical combination frame; at Laumes-Alesia, a unique type of signal box with all-relay operation with route buttons; and at Perrigny, a box of the same type.

This last type of box does not include any interlocking frame, nor is there any electro-mechanical equipment; safety is ensured through the electrical combination of the circuits and the operation of the relays.

New mechanical frames of the unified type have been constructed: one at Laroche, two at the new marshalling yard at Gevrey in order to improve the reception of freight trains and the change-over of locomotives, in the railway centre of Dijon. The Montereau signal box, which replaces three large mechanical frames and which has taken in two others, is a typical example of what has been done by way of modernization. The desk includes 306 miniature push-buttons, and the installations depending on this box are divided into three zones—north, centre and south. The centre and south zones, which are not visible from the box, are connected to it by telecommunication circuits.

The line from St. Florentin to Dijon is provided with central traffic control which permits reversible two-way working on the two main tracks, so that trains may be allowed to operate as required in either direction on each track. For this purpose both tracks have been equipped with luminous automatic block gear for both directions of running. Central traffic control consists of placing in the hands of a single operator, the traffic regulator of the central control position at Dijon, the control of the points, signals and direction of running on each track of the section of line on which reversible two-way working has been instituted. Designed for the St. Florentin–Dijon route, the " CCC " system has been put into service on the first stage between Blaisy-Bas and Dijon, which is 27 km long.

The advantages of " CCC " working include automatic cancellation of routes; flexible transit, i.e., the points are liberated and may be operated as soon as the last part of a train or trains disengages them; permanent setting up, i.e., the route may be kept set up for trains following the same route in succession; the automatic block alone remains in operation as on a straight-through track and the regulator is allowed to give to the smaller stations authority to carry out local shunting operations and other movements.

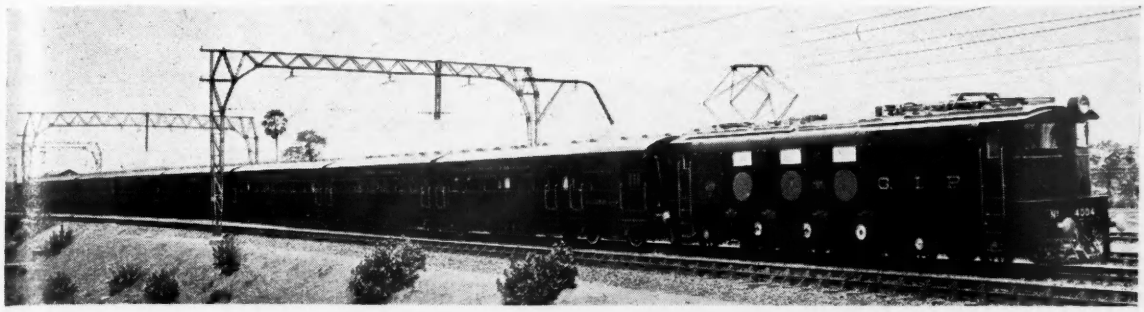
All the installations are fed with 50 c/s a.c. This supply has been carried out with special care in view of the extremely important role played by electrical control in the signalling system, particularly in the block apparatus and the signal boxes. This current is normally provided from the traction substations, and is brought into special signalling supply substations; these also house emergency diesel generating units which start automatically if the supply fails. Two 3,200 V a.c. cables ensure the supply to local feeding points, where the supply is transformed to a lower voltage.

London's Trolley-Buses

COMMENTING on Mr. Lennox-Boyd's statement in the House of Commons on 12th May that only 1,830 diesel buses will be needed to replace London's 1,800 trolley-buses, the British Electrical and Allied Manufacturers' Association said last week that this can only lead to a reduction in Greater London's bus services and, consequently, to an increase in passenger queues. Trolley-buses carry 70 passengers each, against 64 carried by the new diesel buses, so that to carry the same number of passengers, 10 per cent (180) more vehicles will be required. This will add to London's traffic problems.

The Minister's argument that oil buses are more mobile than trolley-buses cannot be substantiated. Trolley-buses speed up traffic flow because of their greater gearless acceleration and smoother braking qualities. As well as maintaining higher schedules this leads to greater passenger comfort.

The B.E.A.M.A. finds it difficult to understand the London Transport Executive's decision to replace trolley-buses by oil buses in view of the fact that the diesel buses and coaches incurred a deficit of £317,000 in 1952 (1953 figures not yet published) against the trolley-buses' surplus of £321,000.



Traction Developments in India

Electrification of Main and Suburban Lines

By P. L. VERMA, B.Sc., M.I.E.E., M.I.E.(India)*

THE inland traffic between the great port of Bombay and North-East, East and South India is carried by the Central Railway. At Kalyan Junction, which is about 33 miles from Victoria Terminus, the main lines bifurcate into north-east and south-east directions. The railway tracks from Victoria Terminus to Igatpuri on the north-east section, a distance of about 85 miles, and to Poona on the south-east section, a distance of about 120 miles, are equipped for electric traction and all passenger and goods traffic is electrically hauled.

In addition to the main line services, the Central Railway also caters for heavy suburban traffic between Victoria Terminus and Kalyan, Victoria Terminus and Kurla, via Harbour Branch, and to Bandra (Western Railway—formerly B.B. & C.I. Railway) via Raoli Junction and Mahim Chord. The electrified lines of the Central Railway along with the positions of power stations, traction substations and the transmission lines are shown in the map on page 941.

The system of electrification adopted is 1,500 V d.c. supplied through overhead contact wires to the trains from various substations. The return circuit is through the track rails, and in order to obtain electrical continuity the rail joints of the electrified tracks are bonded by means of concealed copper bonds. There are in all 16 sub-stations for converting a.c. to d.c., five on the Bombay-Kalyan section, five on the Kalyan-Igatpuri section and six on the Kalyan-Poona section.

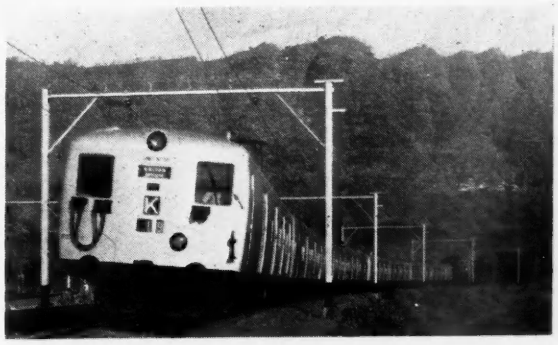
On the Bombay-Kalyan section, including the Harbour Branch, power for electric traction is received from the Tata Hydro-Electric Agencies' main substations at Dharavi and Kalyan at 22 kV, three-phase 50 c/s and delivered by means of overhead transmission lines and underground cables at the railway's converting substations at Wadi Bunder, Dadar, Kurla, Thana and Kalyan.

Power for the main lines, i.e., the Kalyan-Poona section on the south-east and the Kalyan-Igatpuri section on the north-east, is generated at the railway's own power house at Thakurli near Kalyan. This steam generating station was originally equipped with four 10 MW turbo-alternator sets and six coal-cum-oil-fired boilers of 60,000 lb/hr steaming capacity each, at 270 lb/sq in and 730 deg F. The power house was extended during 1950–53 by the installation of two 12 MW turbo-alternators with three coal-cum-oil-fired boilers of 150,000 lb/hr capacity at 425 lb/sq in and 775 deg F. The Kalyan power house also supplies the entire power for Western Railway's electrified lines.

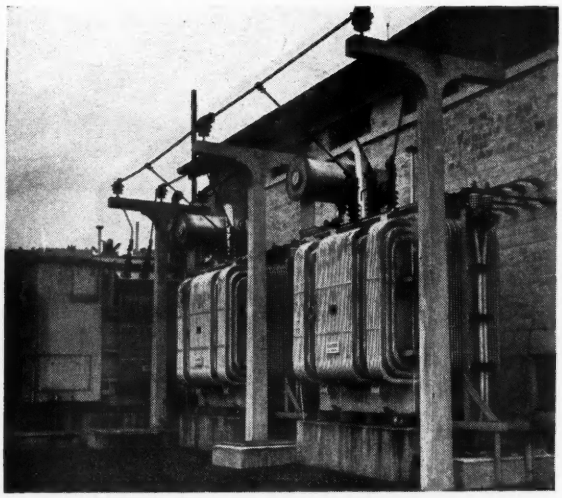
The power is generated at 6,600 V, three-phase 50 c/s and stepped up to 95 kV and distributed by means of duplicate transmission lines to 11 converting substations on the north-east and south-east lines beyond Kalyan. These e.h.v. lines run on either side of the electrified tracks, except for a small portion between Karjat and Lonavla on the south-east where they follow an independent alignment because the section is in the Bhore Ghat where it was not found possible to run them near the track. The conductor used is steel cored aluminium (7/·062 galvanized steel and 6/·186 aluminium) having a nominal cross sectional area of 0·1 sq in copper equivalent.

The substations on the south-east are situated at

The "Deccan Queen," the fastest train on the Central Railway, is seen at the top of the page, and below: one of the new multiple-unit electric trains



* Chief Electrical Engineer, Central Railway.



External view of Dadar rectifier substation

Vangani, Karjat, Thakurwadi, Lonavla, Kamshet, Dehu Road and Kirkee and on the north-east at Vasind, Thansit, Kasara and Igatpuri. These are normally connected alternately to their respective 95 kV transmission lines so that, in case one of these lines trips on fault, the 1,500 V d.c. supply will be maintained by alternate substations left connected to the other line. Thakurwadi substation which is situated on the Bhore Ghat is an exception and is supplied at 22 kV from Karjat substation.

At all the substations except the one at Dadar the h.v. a.c. is stepped down and converted to d.c. by means of rotary convertors and fed to the overhead equipment of the tracks at 1,500 V for working the trains. At Dadar substation steel tank mercury arc rectifiers have been used. The latter is the most modern substation in the electrified system and was brought into service in 1946.

Midway between the substations are placed the track sectioning cabins which are fitted with 1,500 V d.c. circuit breakers by means of which the overhead conductors may be sectionalized. When all the circuit breakers are closed the overhead lines of the tracks concerned, besides being made through are also paralleled on to a common busbar so as to reduce the overall electrical resistance of the conductors and thus reduce the voltage drop.

On the Bombay-Kalyan section the substations are manned throughout the day and night, but on the Kalyan-Poona and Kalyan-Igatpuri sections all the substations and track sectioning cabins are remote-controlled from a central supervisory control room at Kalyan. The supervisory system is split up into five systems; systems 1 and 2 are for the south-east section and 3 and 4 for the north-east section, No. 5 being for Kalyan substation only. In the case of the south-east and north-east, each system of respective pairs, namely 1 and 2 or 3 and 4, is connected to alternate substations and half a track cabin of the section concerned.

High-speed circuit breakers of the track sectioning cabins on the main line are fitted with an automatic reclosing feature which means that as soon as the corresponding track sectioning feeder breaker is closed the high-speed breaker closes automatically. The supervisory control system which controls the feeder breakers to the substation is so connected as to control the track cabin circuit breakers fed from the next substation. Such a system of connections, combined with the automatic reclosing feature of the high-speed circuit breakers, ensures continuity of supply on the 1,500 V side in case one supervisory system fails, because the feeder breakers at alternate substations could be controlled by the other, "healthy," system, and these would cause the corresponding two breakers in track sectioning cabins to close automatically.

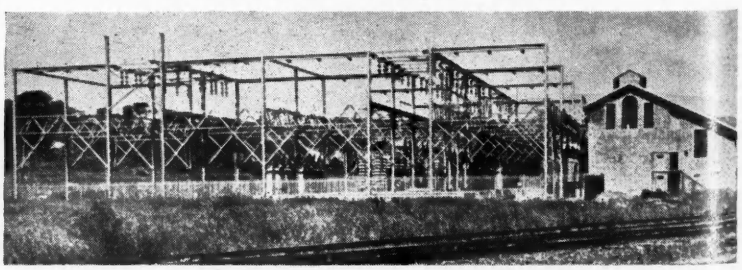
The remaining two breakers are connected to the system which remains in service. Therefore, if one supervisory system fails, the continuity of the 1,500 V supply can still be maintained throughout the section. If both the systems fail, then the only alternative left is to man the substations and operate them on local control. When the substations are on remote control and any of the remote controlled devices operate automatically owing to a fault or any other reason, the attention of the operator in the supervisory control room is drawn both by an audible as well as a visual signal, and the light in the control key indicating the position of that particular device starts flickering.

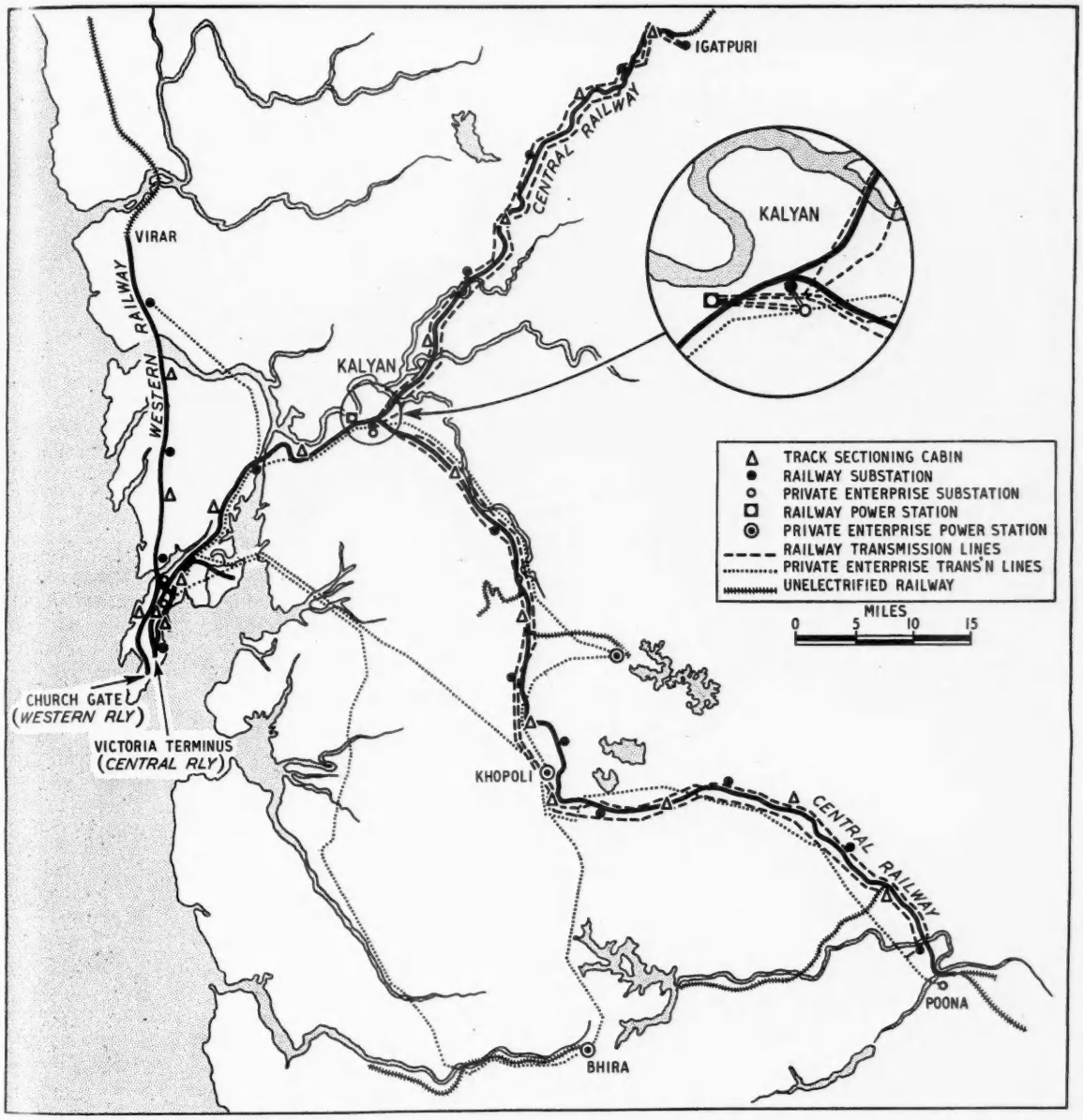
The wires for supervisory control are cadmium copper conductors having a diameter of 0·1 in and are carried on brackets fixed to the track structures in the open section; when negotiating tunnels they are either carried on independent masts over the tunnels or taken through a cable which is suspended on hangers fixed on the walls of the tunnels.

The overhead equipment of all running tracks (mostly four tracks) and junctions between Bombay and Kalyan is of the simple catenary system, comprising one stranded copper catenary (0·375 sq in) and one copper contact wire (0·25 sq in) per track. The total copper cross-sectional area of the overhead equipment is 0·625 sq in. A normal spacing of 220ft has been adopted for the structures. Steel structures carrying the overhead equipment are normally of the portal bridge type and span all electrified track, but in some places owing to lack of clearance between tracks they are of head span construction, in yards. Structures are fabricated from rolled steel sections.

For the main lines beyond Kalyan, where the four-track construction terminates and two tracks start towards the north-east up to Igatpuri and two to the south-east up to Poona, on which gradients are very frequent and in many places very heavy (1 in 34), the total cross-sectional area of the overhead equipment has been increased to 1·0 sq in. Therefore, a compound catenary system has been adopted for the overhead equipment, comprising one stranded copper main catenary of 0·5 sq in section, one stranded copper auxiliary catenary of 0·2 sq in section and one contact wire of 0·3 sq in per track. The steel structures carrying the overhead equipment are of the bridge type spanning two tracks and are normally made from broad flanged beams, the masts being planted into cored holes in the foundations and grouted in.

External view of a main line rotary convertor substation





Map showing the electrified sections of the Central and Western Railways, which receive electric power from Kalyan power house

The present multiple-unit rolling stock consists of 67 four-coach units, out of which 51 are the old stock put into service at the time of inception of the electrification and 16 are of the new light-weight type added in 1951. In the case of old stock, the four-coach unit consists of one motor coach and three trailer coaches. Each motor coach carries four 275 h.p. traction motors, two on each bogie. The remaining three coaches are trailers; two of them are provided with driving cabs and are called driving trailers. The standard composition of a four-coach unit rake for the old units on this railway consists of a driving trailer, a trailer, a motor coach and a driving trailer. There are three driving positions (cabs) in each four-coach unit rake, one at each end of the train and one in the motor coach. These units are fitted with vacuum brakes.

The new four-coach unit, however, consists of two motor coaches and two trailer coaches. Each motor coach carries four 175 h.p. traction motors, two on each bogie. The marshalling order of the unit is motor coach, trailer, trailer, motor coach. These units are fitted with Westinghouse air brakes.

The traction motors are nose-suspended and are geared to the road wheels. The other electrical equipment is carried in a locked compartment in the motor coach itself. On the roof of each motor coach there are two pantographs but only one is used at a time. The traction motors are grouped in pairs so that in case of a failure of one, the pair belonging to the defective motor may be cut out, enabling the train to be run on the other pair at a reduced speed. Both the new and the old units are designed so that they can run through flooded track, which is a common feature on the Bombay suburban sections during monsoon.

As there is a driving position at each end of the train

there is no need to turn the train round at a terminal station; the driver merely changes his position of driving. Two or more of these four-coach units can be coupled together and worked in multiple unit by one driver if the traffic conditions warrant it. This building up of trains to suit traffic conditions is one of the advantages of electrification.

The main line passenger trains are hauled by "passenger" electric locomotives. There are 25 of these, 23 made by Metropolitan-Vickers, one by Brown Boveri and one by the General Electric Co., Ltd. The Metro-Vick locomotives are of the 2AAA1 type, whereas the Brown Boveri and G.E.C. locomotives are of the 2AAA2 type.

The Metro-Vick locomotives are fitted with six traction motors of 360 h.p. each, arranged in pairs and each pair is coupled to the driving axle through a central flexible train of triple gears. These locomotives are designed to haul a trailing load of about 450 tons at 65 m.p.h. on tangent level track. The goods trains are hauled by electric locomotives of the "C-C" type. There are 41 such locomotives supplied by Metropolitan-Vickers. There are six axles per engine, all of which are driving axles mounted in two bogies, three coupled driving axles in each bogie. The axles of a bogie set are connected with side rods. Each locomotive is equipped with four 650 h.p. motors, two per bogie. The power from each pair of motors is transmitted to the driving wheels of that bogie by a jack-shaft mounted in and across the bogie frame. Pinions on the end of each motor mesh with a gear wheel on the jack-shaft which in turn is connected by a connecting rod to the side rods of the bogie. Only freight locomotives are fitted with regenerative braking equipment.

On both passenger and freight electric locomotives the electrical equipment is divided up and is so arranged that a defective portion can be cut out and the engine still retained in service. Both the passenger and freight locomotives have driving positions at both ends with the result that at terminal stations it is not necessary to turn them round as is the case with the steam locos. All main line trains on their journey to Poona on the south-east and to Igatpuri on the north-east have to negotiate the steep inclines of the Bhore and Thull Ghats respectively. The ruling gradient on both these ghats is 1 in 37. Therefore all the passenger and goods trains, while ascending the ghats, are banked in the rear by a freight locomotive. In the descending direction both the passenger and goods trains have an additional freight locomotive put in front of each train so as to bring the train down the ghats under regenerative braking. While regenerative equipment is not designed fully to become the primary brake of the train or to replace the vacuum brake, it results in economy in maintenance of brake gear as well as electric power and safe and easy control of trains descending long gradients. Provision is made in the main line substations for absorbing the energy regenerated by trains when descending the ghats.

The travelling public between Bombay and Poona and Bombay and Igatpuri derives several advantages from electrification. The travelling time from Bombay to Poona which amounted to nearly 6 hours in the steam days has now been cut down to only 3 hours by the fastest train, called the "Deccan Queen." The other advantage of electrification is the clean travel because of elimination of smoke, cinders and fumes. This advantage is specially of great value when passing through 26 tunnels on the Bhore Ghats and ten on the Thull Ghats.

On the Bombay suburban section there are 486 trains coming into and going out of Victoria Terminus every day at intervals of 3 minutes during the peak hours in the morning and evening and fairly frequently during the rest of the day. The number of passengers carried on suburban lines has increased considerably as compared to earlier days. The number of passengers carried on suburban lines in 1925–26 before electrification was 28·3 million whereas in 1952–53 it was 147·8 million. Steam traction could never have been able to handle this intensity of traffic. Thanks to the electrification of railways, Bombay City is one of the few big cities in India which can claim to be practically free from the nuisance of smoke. Whatever little smoke there is in Bombay is due to either the chimneys of the textile mills or the main line trains of the Western Railway which are still steam hauled; but the time is not far off when the Western Railway will also go over to total electrification and make Bombay the cleanest city in India.

Electric Traction Systems Compared

BASIC TECHNICAL AND ECONOMIC ASPECTS

IN the proceedings of the 10th International Railway Congress which opened in London on 19th May, Question 3 (Section 2) calls for "Technical and economic consideration of the basic characteristics of electric traction systems now in use, with a view to deciding whether, and to what extent, there are relevant reasons for preferring one system to another." The Question is dealt with in two papers, one by Mr. S. B. Warder, Chief Officer (Electrical Engineering), British Transport Commission, and one by Prof. Ing. C. Guzzanti, Professor of Electric Traction at Pisa University.

Mr. S. B. Warder's paper reviews data supplied by the United Kingdom, the United States, South Africa, India, Denmark, Norway, and Sweden. Accepting the fact that some lines built in the early days of railways seem doomed to be closed, he points to others where traffic might be stimulated by diesel railcars, or even by electrification if oil is not a natural product of the country concerned. It is on routes of higher traffic density than these, or where a higher density might be developed by providing the services the public wants, that electrification becomes of general interest. Therefore, as punctual, fast, frequent, and comfortable trains are needed, motive power units and types of rolling stock are of fundamental importance. Power supply and fixed installations are secondary to these, Mr. Warder considers, because even if they cost nothing but involved motive power units and rolling stock of unsuitable qualities, the lines would be useless to the railway administration.

The four types of motive power studied in the report are d.c. at 1,500 V and 3,000 V; and single-phase a.c. (11–25 kV) at low frequency or one of the standard industrial frequencies. Where traffic density is high, the system having the best motive power characteristics might be

preferred to one of lower initial cost because it is more likely to regain, retain and attract net revenue-earning traffic. It is still true to say that the d.c. motor has a better traction characteristic than its a.c. counterpart, and it can probably be claimed with justice that the d.c. motor with a wide range of field weakening and with resistance control, operating at 750 V or 1,500 V, is and will remain the simplest, cheapest, and most reliable form of motive equipment.

It is suggested that the multiple-unit train may be pre-eminently suitable for providing safe, rapid, frequent, and comfortable transport of a kind which could enable the railways to take a profitable lead once more in this sphere. With the low centre of gravity and light leading axle loads of motor coaches, speeds of 90 m.p.h. and over can be maintained without difficulty over long distances. Another advantage is that in multiple-unit trains supplies are directly available on each unit for lighting, heating, cooking, refrigeration, ventilation and other purposes. For locomotive-hauled trains much of this power is often furnished by axle-driven generators, so that it absorbs valuable tractive effort. The elimination of the large steam-heating boiler would be generally welcomed.

Electric motor coaches might find further use for conveying light parcels and easily-handled freight of types which are being increasingly carried by road, with considerable loss to the railways. This is a field in which light fast parcels motor coaches or multiple-unit trains in conjunction with suitable feeder services might score an unexpected success.

The paper passes from motive power to fixed installations, and draws attention to the economies made possible by the use of oil-filled cables as 33 kV or 66 kV feeders. For d.c. systems mercury arc rectifiers have become standard practice at substations, and with grid control can be used satisfactorily as invertors when regenerative braking is desired. For low-frequency a.c. systems, although in theory grid-controlled rectifiers could be used, it seems likely that the practice of using rotating machine type frequency changers will continue as, instead of creating rather difficult harmonic disturbances, their motors can be compensated so as to produce leading wattless current which goes a long way towards compensating for the lower efficiency of frequency changers.

A section of the report deals with overhead contact lines and the effect on capital costs of the clearances required, particularly with high-voltage a.c. systems. It is quite easy to spend on altering one overbridge as much as for a single track-mile of overhead construction. In one example in Great Britain the cost of structural alterations has been 15 per cent of the cost of the overhead equipment (including structures and foundations). This factor is a principal reason why it is so difficult to make a general assessment of the position of the higher-voltage systems.

Electrification Estimates

Estimates are given of the cost of electrifying two simple imaginary lines with different traffic characteristics, either at 1,500 V d.c. or 25 kV, 50 c/s single-phase a.c. On a busy section of 90 route-miles, worked by 72 motive power units, a total cost in both cases of £8,600,000 is computed. The high-voltage scheme saves on overhead line costs but involves three times the expenditure on clearances, twice that on signalling, and a third more on telecommunications modifications. Its motive power units are estimated to cost £3,700,000 against £3,200,000. Substation and feeder costs, however, are put at £300,000 against £800,000 for the d.c. scheme.

The second example is a section of 360 route-miles with light traffic, worked by 24 motive power units. Here the 50 c/s scheme is estimated to involve only 55 per cent of the capital cost of the 1,500 V d.c. electrification. Motive power units are again shown as costing 15 per cent more for the 50 c/s scheme than for d.c.

These investigations lead the author to conclude that on a line with heavy traffic there may well be nothing to choose between the two systems when all factors are considered, but that there is a marked advantage in adopting a high-voltage system on long, lightly-loaded lines. The same comparison is expected to apply to operating costs. The two cases, in fact, give concrete expression to the reporter's warning in his introduction of the difficulty of stating categorically that any one system of electrification can be preferable to all others for all railways at this or any other time.

OVERSEAS PRACTICE

In the paper on the same subject Professor Guzzanti deals with systems in Algeria, Belgium, the Belgian Congo, France, Western Germany, Holland, Hungary, Italy, Morocco, Spain, and Switzerland. Reviewing substation practice, he mentions the experiments by the German railways at Basle with mercury arc rectifiers operated with grid control to give phase and frequency conversion. In this way a low-frequency single-phase railway could be supplied from three-phase, high-voltage distribution lines, but no information has been received for inclusion in the present report on the possibilities of this system or the reasons which have discouraged its development.

The reporter attaches some importance to the ease with which regenerative braking can be employed when assessing the merits of different electrification systems. Only the Spanish National Railways among those replying to him operate rectifiers as invertors for this purpose, and do so only at one substation. He considers that this apparent lack of confidence in invertor rectifiers would put d.c. electrification, especially at 3,000 V, in a difficult position if this method of operation were considered indispensable.

Professor Guzzanti discusses the unbalance of a three-phase network by a single-phase, 50 c/s traction load. He considers that although the 50 c/s system may justify electrification of lines with lower traffic density than usual, the power required will not be inconsiderable, and the power in the public supply system must be much higher for conditions to be acceptable. Therefore it is suggested that the single-phase, 50 c/s system is appropriate only in areas where industrial development has created a large consumption of electric power. If it is adopted in places where the industrial load is small, the traffic on the railway would necessarily be so light that there would have to be some exceptional considerations to justify electrifying it at all.

The author then discusses overhead supply systems and recalls the fact that the benefits of higher voltages are not experienced to the same extent on d.c. and a.c. systems because of the effects of reactance in the latter. Substation spacing can be wider on a low-frequency a.c. system than on one supplied at 50 c/s, the voltages being the same. With equal voltages, overhead lines of similar characteristics, and comparable traffic conditions, d.c. substations can be more widely spaced than those of an a.c. system.

The upper voltage limit for d.c. electrification is placed at about 3,000 to 3,400. Although rectifiers could handle 6,000 V, there would be difficulties with track feeder circuit breakers, and in locomotives or motor coaches it would be necessary to have several motors always connected in series. This would involve more complex wheel arrangements in locomotives, or several motors per axle,

and the operation of motor coaches in permanently-coupled sets.

Reviewing locomotive development, the reporter notes the trend towards designs in which all axles are used for adhesion. Modern electric motive power is therefore well adapted to mixed traffic duties and this characteristic enables it to be used intensively. This is true of locomotives for all electrification systems except for certain 50 c/s machines with rotary convertors which have been built specifically for heavy freight duties. A survey of power outputs in terms of horsepower per ton shows the highest figures among low-frequency single-phase locomotives, typical examples being 39 to 61 h.p. per ton in mixed traffic types and 37 h.p. per ton in freight locomotives. All these locomotives have commutator motors and therefore need to be able to accelerate rapidly through the zone of bad commutation at starting.

Emphasis is laid on the necessity of judging the efficiency of a locomotive in relation to total operating costs. A slight loss in electrical efficiency is acceptable in a locomotive that permits large economies in working the railway. Professor Guzzanti expresses much interest in the possibilities of locomotives with rotary convertors or motor-generator sets, because of their capacity for heavy haulage and consequent reduction in the numbers required to work a given traffic. He describes the convertor designs for the Valenciennes–Thionville 50 c/s electrification of the French National Railways and mentions motor coach stock for the same system of working. The replies he has received do not indicate that the 50 c/s motor coach has yet fully proved itself, and he is of the opinion that for any traction system to be acceptable to-day it must permit the use of motor coach trains both for local services and long-distance, high-speed trains.

The question of deciding the most suitable system of electrification is approached by making estimates of the cost of electrifying the Milan–Venice line of the Italian State Railways, either with 3,000 V d.c. or single-phase, 50 c/s a.c. Trains are numerous but not heavy, and in present conditions the final saving of a 50 c/s scheme would be barely 9 per cent. If the number of motive power units could be halved, however, there would be a reduction in the total cost of 22 per cent in favour of the 50 c/s system. It is therefore concluded that the deciding factor is the traffic, because if this can be handled by a small number of trains—heavy when necessary—a system which reduces the cost of the fixed installations is the one which shows satisfactory economies in the total cost of electrification.

Two developments to look for in the future are named by the author in his conclusions. One is improvement in the mercury arc rectifier to permit d.c. systems to return power to the distribution network with simple apparatus; and the second is a method of connecting low-frequency single-phase systems direct to the public supply through static phase and frequency convertors.

On the question of different electrification systems existing side by side, the author sees no alternative to accepting the situation and changing locomotives at frontiers unless dual-system locomotives are further developed. Such development is only likely to occur, however, if adjacent countries find it convenient to interchange their motive power units freely. Where a country has a widely developed electrification on one of the established systems, three conditions are suggested for building up a 50 c/s system alongside it. They are: (1) that the two zones have only a limited number of stations in common; (2) that traffic density in the 50 c/s zone is lower and can be handled by a limited number of trains; and (3) that good use of locomotive stock is possible in both zones.

In such circumstances it may be expected that in the zone with lower traffic density the 50 c/s system can be used with satisfaction and economic benefit.

Board's Requests to Manufacturers

Further Suggestions for Co-operation

LAST week the South Eastern Electricity Board held its eleventh meeting with manufacturers' representatives at Brighton. As is customary, Mr. W. R. T. Skinner, deputy chairman of the Board, presided and he was supported by principal officers of the Board.

Mr. Skinner opened by reporting on the Board's progress in 1953–54 which saw a record number of new connections—over 35,500 and 14·5 per cent more than in 1952–53. More than two-thirds of the farms in the Area now had electricity. Since the Board's beginning six years ago the number of consumers had risen by 22·4 per cent.

Since the last meeting the electrical "climate" had improved, with reductions in purchase tax, the lifting of the ban on promotional advertising, the better generating plant position, etc.

A year ago some representatives at the meeting expressed concern at the Board's reduced rate of ordering in order to run down stocks. That phase was passing and purchasing was now more in line with day-to-day needs. Happily the need to formulate a policy to regulate the purchasing of foreign goods had not arisen; he hoped that this would continue to be the case and that such relative scarcities as they had experienced would rapidly disappear altogether.

They had had complaints from the Districts about the condition of some appliances upon delivery. Sometimes this was due to insufficient inspection before dispatch, sometimes damage might have been done before packing, and there were instances of damage in transit through insufficient packing. He asked the manufacturers to consider these matters to avoid delay and expense.

Mr. Skinner said that although the Board notified unsuccessful tenderers that a contract had been placed it could not give them the price of the accepted tender.

He asked manufacturers to be careful in timing their publicity for new products lest they created a demand which they could not meet for some time. He also suggested that in their advertising manufacturers should not concentrate entirely on their own products but say something also about the advantages of the electrical way generally. Another point was that information about productions shown for the first time at exhibitions should be sent simultaneously to the Board so that it would be able to answer inquiries at its showrooms—which numbered over 90.

RAILWAY ELECTRIFICATION EQUIPMENT

In this section, particularly for the benefit of those concerned in other countries, we provide some information regarding British manufacturers of railway electrification equipment and materials

A.I. Electric Welding Machines, Ltd., 68, Victoria Street, London, S.W.1.—Automatic flash butt welders for rail joints, carriage and wagon assembly.

Arrow Electric Switches, Ltd., Hanger Lane, Ealing, W.5.—Small toggle switches for railway lighting fittings and special 30 A d.p. tumbler switches.

Baldwin, H. J., & Co., Ltd., 606, Mansfield Road, Nottingham.—Cable protection covers, precast concrete ware and stoneware conduit.

Bill Switchgear, Ltd., Aston Lane, Perry Barr, Birmingham, 20.—Air-break l.v. switch and distribution gear up to 660 V, 10 A to 600 A, including fuseboards, switchfuses, busbar chambers and industrial panels.

B.M.A.C., Ltd., 2, Hornsey Road, Holloway, London, N.7.—Bell pushes, plugs and sockets, and lighting fittings, etc., for rolling stock.

Bolton, Thomas, & Sons, Ltd., Mersey Copper Works, Widnes, Lancs.—Wire in copper, brass and bronze, trolley wire, h.c. copper end rings and busbars, rail bonds, pantograph collector strips, and special alloys for welding electrodes.

British Insulated Callender's Cables, Ltd., 21, Bloomsbury Street, London, W.C.1.—Overhead traction equipment, power cables and overhead transmission lines for the main supplies, feeder cables for track equipments and signalling cables.

British Thomson-Houston Co., Ltd., Rugby.—Steam and gas turbo-generator sets, rectifier substation equipment, electric and diesel-electric locomotives, traction motors and control equipment.

Broadbent, Thomas, & Sons, Ltd., Central Ironworks, Huddersfield.—Electrically operated capstans.

Brush Bagnall Traction, Ltd., Loughborough.—Diesel-electric locomotives for main line and shunting duties from 300 to 2,000 h.p.

Bullers, Ltd., Milton, Stoke-on-Trent.—Conductor rail, end-strain, catenary register-arm and distance insulators and fittings, and special attachments for countering the effects of electrolysis on d.c. systems.

Cable Covers, Ltd., St. Stephens House, Westminster, London, S.W.1. — Overhead transmission line connectors and terminating clamps, stay rods, and automatic mid-span connectors.

Chilton Electric Products, Ltd., Hungerford, Berks.—S.p., d.p. and triple-pole miniature circuit breakers up to 60 A, 550 V a.c. or 250 V d.c.

Crabtree, J. A., & Co., Ltd., Lincoln Works, Walsall.—Electrical accessories and fusegear and coach lighting tumbler switches.

Craigpark Electric Cable Co., Ltd., Flemington Street, Springburn, Glasgow.—Rubber compound and p.i. cables for all signalling and traction purposes.

Cressall Mfg. Co., Ltd., 31 & 32, Tower Street, Birmingham, 19.—Air conditioning heaters, heater units, head lamp dimmers, resistors and resistor units. Shunt field regulators for diesel-electric traction.

Crompton Parkinson, Ltd., Crompton House, Aldwych, London, W.C.2.—Traction motors up to 500 h.p. for electric and diesel-electric locomotives, main and auxiliary generators up to 1,800 h.p., and complete equipments.

Dennis, G. P., Ltd., Fleming Road, Speke, Liverpool. — Medium-voltage switchboards, switchfuses and distribution boards and heavy-duty fused switches up to 800 A.

Dorman & Smith, Ltd., Ordsal Electrical Works, Salford, Manchester, 5.—Miniature circuit breakers, t.s. fused switches, lighting fittings, fuses and fuseboards.

Doulton & Co., Ltd., Doulton House, Albert Embankment, London, S.E.1.—Third rail porcelain insulators and overhead line porcelain insulators with d.c. and a.c.

Dubilier Condenser Co. (1925), Ltd., Victoria Road, North Acton, London, W.3.—Oil immersed paper dielectric capacitors, adjustable and fixed types for signalling systems, d.c. smoothing and filter capacitors and lightning arrestor capacitors.

Edison Swan Electric Co., Ltd., 155, Charing Cross Road, London, W.C.2.—Signalling and track feeder cables, copper wire and strands, train lighting cells and accumulators for signalling purposes.

Electric Transmission, Ltd., Etruria, Stoke-on-Trent.—Track isolating switches, a.c. and d.c. h.v. cartridge fuses and mercury-arc rectifier anode fuses.

Electro Mechanical Mfg. Co., Ltd., Marlborough Street, Scarborough, Yorks.—Switch and switchfuse gear and contactor starter gear for substations.

Elliott Bros. (London), Ltd., Century Works, Lewisham, London, S.E.13.—Special indicating and recording equipment and long-scale switchboard instruments.

English Electric Co., Ltd., Queen's House, Kingsway, London, W.C.2.—Complete electric and diesel-electric traction equipments and rolling stock, rectifiers, and power station and substation equipments.

Erskine, Heap & Co., Ltd., Lancashire Switchgear Works, Salford, Manchester, 7.—Switchgear and motor control gear for power stations, substations and workshops.

Evershed & Vignoles, Ltd., Acton Lane Works, Chiswick, London, W.4.—"Megger" insulation testers and earth resistance testers, "Ducter" low resistance testing sets and "Evershed" recorders.

Ferranti, Ltd., Hollinwood, Lancashire.—"Nomag" non-magnetic resistance grids for traction control involving constant usage and heavy overloads.

General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2.—Traction equipments for electric and diesel-electric locomotives, turbo-alternators, mercury-arc rectifiers and all substation switchgear, h.v. and l.v. distribution cables, complete control systems and instruments, traffic control telephone installations, sound equipment, v.h.f. radio, interior and exterior lighting and lamps, infra-red heating, cooking and heating equipment, ventilating equipment and all types of installation material.

Hackbridge & Hewittic Electric Co., Ltd., Walton-on-Thames, Surrey.—Mercury-arc rectifiers for heavy-duty traction service, 600, 1,500 and 3,000 V d.c.

Henley's, W. T., Telegraph Works Co., Ltd., 51–53, Hatton Garden, London, E.C.1.—All types of cables including those for the internal wiring of rolling stock and signalling systems.

Johnson & Phillips, Ltd., Charlton, London, S.E.7.—Rubber and thermoplastic cables, p.i. aluminium or lead sheathed up to 33 kV and cable accessories including joint boxes, link boxes, glands and feeder pillars, h.v. and l.v. substation switchgear, transformers, reactors and power capacitors.

Liverpool Electric Cable Co., Ltd., 24, Queen Anne's Gate, London, S.W.1.—Electric cables and rail bonds.

McGeoch, William, & Co., Ltd., 46, Coventry Road, Birmingham, 10.—Coach interior electrical fittings, watertight plugs and sockets, indicator light fittings and various types of switch and fuse gear for power stations, workshops, etc.

Metropolitan-Vickers Electrical Co., Ltd., Trafford Park, Manchester, 17.—Complete equipments for electric and diesel-electric locomotives including gas turbo-electric locomotives. Circuit breakers, contactors, control equipment for all classes of traction rolling stock, gears, diesel-electric generators, traction motors, pantograph collectors, complete signalling equipment, resistors, speed indicating equipment and lighting equipment.

Morgan Crucible Co., Ltd., Battersea Church Road, London, S.W.11.—Carbon brushes for main traction motors and diesel driven traction generators, contacts for diesel engine starting motors, sliding door interlocks and signalling relays, and pantograph carbons and carbon pile regulators.

Nevelin Electric Co., Ltd., Purley Way, Croydon, Surrey.—Glass bulb mercury-arc rectifiers.

Parsons, C. A., & Co., Ltd., Heaton Works, Newcastle-on-Tyne, 6. — Complete turbo-generator units.

Partridge, Wilson & Co., Ltd., Davenset Electrical Works, Evington Valley Road, Leicester.—Battery charging equipment consisting of rectifying plant for the charging of coach-lighting batteries at stations.

Permali, Ltd., Bristol Road, Gloucester.—Insulating rail joints for track circuits, baseplates, collector shoe beams, switchgear components, guard boards and section insulators for overhead conductors.

Petbow, Ltd., Sandwich, Kent.—Generating plant, welding plant, welding electrodes and accessories, traffic signal sets, battery charging plant and air compressors.

Pirelli-General Cable Works, Ltd., Southampton.—Stainless steel sheathed and other cables.

Quasi-Arc Co., Ltd., Bilston, Staffs.—Arc-welding electrodes, plant and accessories, a.c. and d.c. welding sets.

Record Electrical Co., Ltd., Broadheath, Altrincham, Cheshire.—Ammeters, voltmeters, speedometers and overspeed cut-outs.

Siemens Brothers & Co., Ltd., Woolwich, London, S.E.18.—Cables, joint boxes and accessories, overhead line material, telecommunication cables and cable accessories, telephone apparatus, signalling apparatus, lamps, meters and insulating materials.

Sperryn & Co., Ltd., Moorsom Street, Birmingham, 6.—Heavy-duty lampholders specially designed for railway conditions.

Standard Telephones & Cables, Ltd., Connaught House, Aldwych, London, W.C.2.—Cables, signalling systems, train describers, traffic control equipments, telephones and rectifiers.

Statter, J. G., & Co., Ltd., 82, Victoria Street, London, S.W.1.—H.v. metalclad substation switchgear, l.v. traction type switchboards, air-break circuit breakers, sectionalizing switches and knife switches.

Stone, J., & Co. (Deptford), Ltd., Deptford, London, S.E.14.—Air conditioning equipment, batteries, bearings, distance counters, transmission gear, generators for train lighting, electric heating equipment, indicator equipment, lighting fittings for trains and locomotives, automatic regulators, speed indication equipment, switchgear, electrical testing equipment, and ventilating equipment.

Switchgear & Equipment, Ltd., Southam Road, Banbury.—Automatic track sectionalizing load-break switches.

Unity Heating, Ltd., Chilworth Manor, Southampton.—Tubular traction-type heaters for use in carriages, etc.

Vulcan Foundry, Ltd., Newton-le-Willows, Lancs.—Electric and diesel-electric locomotives.

Walters, Austin, & Son, Ltd., Ayres Road, Old Trafford, Manchester.—L.v. transformer equipment for lighting, power, etc., for rolling stock, substations and workshops.

Westinghouse Brake & Signal Co., Ltd., 82, York Way, King's Cross, London, N.1.—Brakes and signals, battery charging equipments and rectifiers for auxiliary circuits.

Whipp & Bourne, Ltd., Switchgear Works, Castleton, Rochdale.—D.c. high-speed circuit breakers up to 3,000 V and low voltage a.c. switchgear.

White Electrical Instrument Co., Ltd., 10, Amwell Street, Rosebery Avenue, London, E.C.1.—Electrical measuring instruments and electrical instruments and equipment for signalling purposes.

Wilcox, Edward, & Co., Ltd., Sharston Road, Wythenshawe, Manchester.—Protective gear, fuses, etc.

Yorkshire Switchgear & Engineering Co., Ltd., Grand Buildings, Trafalgar Square, London, W.C.2.—Indoor and outdoor metal-clad substation switchgear up to 22 kV, 2,000 A.

I.E.E. AFFAIRS

THE INSTITUTION'S ANNUAL REPORT

THE annual report of the Council of the Institution of Electrical Engineers for the year 1953–54 was presented yesterday (Thursday) at the annual general meeting of the Institution. In the introduction it is recorded that though the growth of membership seen in post-war years has been maintained, and though there has again been an increase in the number of graduates, the elections and transfers to this class are not adequate to meet the country's needs for professionally qualified electrical engineers. This problem of adequate recruitment to the profession has presented itself with ever-increasing insistence, and the Council is giving close attention to means of remedying the situation. For example, in view of the importance of making possible an early grounding in general science as part of an entrant's secondary education, the Council supported a conference called by the Federation of British Industries to discuss the adequate provision of science masters in schools. They are also giving attention, in collaboration with the Ministry of Education, to the fullest possible development of the middle stream of technological education, and are paying particular regard to the provision of works-based "sandwich" courses in electrical engineering in addition to the existing part-time day release schemes leading to the granting of ordinary and higher national certificates in electrical engineering which, with suitable endorsements, provide partial exemption from the Institution Examination. Many other references in the introduction to committees, conferences and conventions dealing with engineering education also depict the serious attention which is being given in this field.

The previous high level of the Institution meetings has been maintained and the same applies to the work of the various technical committees, in connection with which it is pointed out that work is actively proceeding on the preparation of a 13th edition of the I.E.E. Wiring Regulations.

Rebuilding Fund

The Council has now decided that £195,330 should be allocated to a rebuilding fund, that a corresponding reserve account should be created by transfer from the surplus of assets over liabilities account, and that the amount of dividend income should be reinvested annually and added to the rebuilding fund.

The Council has decided that a general reserve fund should be created and built up to £25,000, to be used when necessary to meet any deficits on the income and expenditure account which may arise in the future. A transfer of £10,000 to initiate this reserve has been made in the accounts for 1953, and this amount will be separately invested during 1954.

The rate of increase in the membership of the Institution has been well maintained during the session, the number of members elected being 2,400, compared with 2,312 during the previous session. The Membership Committee dealt with 2,404 other applications, mostly for transfer from one class to another, making a total of 4,804. At 1st April, 1954, there were 30,269 corporate members and graduates on the Register out of a total membership of 38,496. The number of graduates increased during the year to 10,717 (10,357 in 1953), and the number of associate members who have transferred to the class of members again compares favourably with previous sessions, but there remain a number of associate members with qualifications entitling them to enter the higher class who have not taken steps to be transferred. Five women were admitted to corporate membership during the year, bringing the total number of women in that class up to 21, their total for all classes of membership being 61.

During the year 136 members took advantage of the rule that members, associate members and associates who have retired from the profession may apply to retain their membership without payment of further subscriptions, provided that they have reached the age of 60 and have had 25 years' continuous membership.

References to the facts that the Council had conferred honorary membership of the Institution on Mr. E. Leete, companion, for his outstanding services to the Institution, and to the thirty-second award of the Faraday Medal to Mr. Isaac Shoenberg, member, for his distinguished work in electrical engineering, are followed by a long list of honours and distinctions conferred on members.

During the year 1,239 meetings of the members, the Council and the various Committees were held in London and at the local centres. Membership of the Sections continues to grow, the present position being as follows:—

	Membership at 31st March, 1954	Number of meetings	Average attendance (figures for last year in brackets)
Measurements Section	2,814	14	87 (122)
Radio Section	4,780	15	165 (243)
Supply Section	3,737	8	139 (144)
Utilization Section	3,691	8	95 (129)

On 1st January, 1954, 16,990 members were attached to the ten local centres as follows: East Midland, 1,097; Mersey and North Wales, 1,189; North-Eastern, 1,242; Northern Ireland, 266; North Midland, 1,773; North-Western, 2,858; Scottish, 1,705; South Midland, 3,220; Southern, 1,461; and Western, 2,179.

Many district meetings were held in smaller towns throughout the country where membership of the Institution is small. It was also evident from the discussions at the conference of honorary secretaries of students' sections held in London in November, 1953, that a great effort was being made by the 17 section committees to provide programmes of meetings and social events which would appeal to the greatest possible number of members.

The activities of the overseas branches and committees were maintained, and ties between the Institution at home and members overseas were strengthened by senior members of the Institution who in the course of their travels abroad addressed meetings of members. During the year the following overseas representatives were appointed by the Council:—Hong Kong: Mr. D. S. Hill (in place of Mr. R. P. Dunlop). Near East: Mr. A. G. Coates. Rhodesia: Mr. A. B. Cowen, O.B.E. (in place of the late Col. A. T. Harpham). Honorary secretary in the United States: Mr. R. H. Barclay (in place of the late Mr. Gano Dunn). West Africa: Mr. J. Houston Angus (in place of Mr. H. Batty).

The committee on electrical exhibitions (which is convened by the Council and includes members nominated by the British Electricity Authority, the Electricity Boards, the British Electrical and Allied Manufacturers' Association and the Cable Makers' Association) has continued to maintain close touch with the authorities of the Science Museum, South Kensington, for the setting up of a new electrical power collection. In addition to the substantial financial contributions which have already been received from the bodies mentioned above, the project has been supported by offers from particular manufacturers to supply detailed exhibits needed to complete the collection.

Separate sections of the report deal with the work of committees concerned with codes of practice, radio interference, regulations for the electrical equipment of aircraft, radio equipment for civil aircraft, model forms of general conditions of contract, basic design temperatures for space-heating installations, and the application of electricity to industrial process heating, etc.

Section D of the report deals with the joint activities with other bodies, while Section E is a particularly long one on education. The Education and Training Committee met twelve times during the year and discussed various aspects of the development of technological education and training. A number of these aspects were also of interest to the Councils of the Institutions of Civil Engineers and of Mechanical Engineers, and early in the session the three presidents decided to form a Joint Advisory Committee on Education to discuss matters of common interest, and from which representatives could be drawn to represent the presidents on suitable occasions. The Joint Committee was set up early in 1953 and the main subject discussed by the Committee has been the development of technological education, with particular reference to the proposal for a new national award in technology. A joint approach to the Minister of Education on this matter has been greatly facilitated by the existence of the Committee. At the request of the presidents, representatives of the Committee have also had meetings to discuss this subject with the National Advisory Council on Education for Industry and Commerce.

The Examinations Committee and the Examinations Sub-Committee for Educational Qualifications met ten times in the year under review. Several diploma courses have been considered and accepted for exemption from, or recognized as courses in preparation for, the appropriate sections of the Institution Examination.

The Joint Committee on Practical Training in the Electrical Engineering Industry met twice during the year and considered in some detail the reports of three specialist panels which were set up to examine the general pattern and nature of the training of electrical engineering graduates in the respective fields of heavy-current manufacture, light-current manufacture, and the public utility undertakings. They decided to revise the 1947 Report on the Practical Training of Professional Electrical Engineers and to include the recommendations of the three panels in the section dealing with schemes of practical training. The Joint Committee also reviewed briefly the practical training facilities for overseas students, vacation training and the place of the industry-based "sandwich" course as the alternative method to the traditional student apprenticeship, with part-time day release, for educating and training the professional electrical engineer.

Cable Operating Temperatures

THE allowable maximum operating temperatures which are now in use for the calculation of current ratings for paper insulated and varnished cambric insulated mains cables have been established at their present level for approximately 20 years. It is proper that the basis of calculation should be subject to review from time to time, and the Cable Makers' Association has recently given active consideration to the question. As a result the Association is able to recommend an increase of 10 deg C in the maximum working temperature for all such cables operating at voltages up to 6·6 kV inclusive. This increase will apply to existing cables as well as to new cables, and it will mean that the permissible conductor temperatures for cables installed in air or laid direct in the ground will now be 80 deg C instead of 70 deg C. In ducts unarmoured cables will be limited to a maximum of 60 deg C, but aluminium sheathed or armoured lead sheathed cables may operate at 80 deg C.

The effect of this change in temperature limits will be to increase the present current ratings and, pending the issue of new tables of ratings, the following factors may be applied with reasonable accuracy to the present values published in E.R.A. Report F/T128 for lead sheathed cables. For cables having either aluminium conductors or aluminium sheaths or both, these factors should be taken in conjunction with the tables of correction factors recently issued by the C.M.A. This information was published in the *Electrical Review* of 19th February, 1954.

When the higher operating temperatures referred to above are employed the factors already published to take account of variations in ground or air temperature will also need modification and the values in Tables II and III will apply.

In the case of 11 kV cables other considerations have to be taken into account since the operating stresses are higher. The C.M.A. is giving further attention to this matter.

TABLE I—General factors relating to present ratings. TABLE II—Relating to cables laid direct in the ground or drawn into ducts. TABLE III—Relating to cables installed in air

TABLE I		TABLE II			TABLE III	
Type of installation	Rating Factor per cent	Soil or Duct Temperature deg C	Percentage rating factors for final conductor temperature of:— 60 deg C	80 deg C	Air Temperature deg C	Percentage rating factors for final conductor temperature of 80 deg C
All cables laid direct in the ground Aluminium sheathed cables in ducts Armoured lead sheathed cables in ducts	1·07	20 23 25	94 91 88	96 94 92	30 32	95 93
All cables installed in air	1·09	27	86	90	35	90
Unarmoured lead sheathed cables in ducts	1·12	30 32 35	82 79 74	88 86 83	40 45	84 79

Discharge Lamp Manufacture

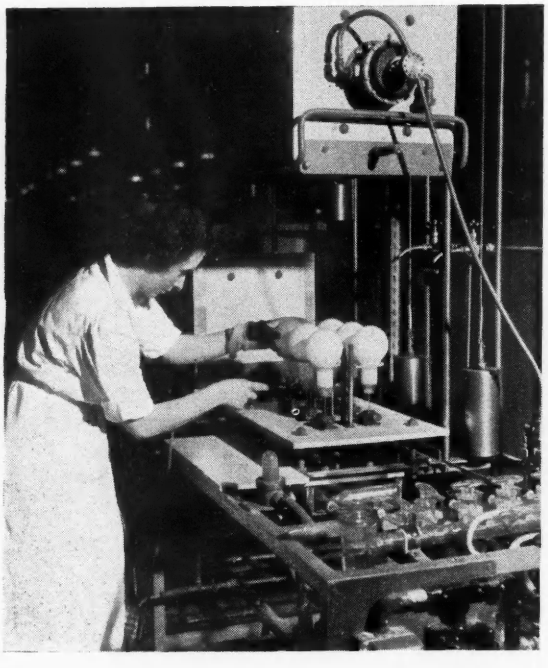
TECHNIQUES EMPLOYED AT THE B.T.H. LEICESTER WORKS

In view of the recent developments in discharge lamp design, resulting in both increased efficiency of operation and longer life, it was of particular interest to us to visit the Leicester Lamp Works of the British Thomson-Houston Co., Ltd., last week to see the lamps being made and to learn how some of the improvements have been achieved. The works were originally built for war production and were equipped for lamp manufacture in 1945. Since then machinery has been installed, labour trained and provision made for the production of over 500 types of lamp. Despite the trend towards mechanized production in the manufacture of most types of lamps, many of the processes of discharge lamp manufacture rely upon the skill of craftsmen in glass.

Sodium discharge lamps are made in 45, 60, 85 and 140 W sizes and as the basic principle and design has remained almost static since its introduction the considerable increase in performance and efficiency are the results of detailed improvements. Typical of these improvements is the development of a "hard" glass which allows the use of "matching" alloy sealing wires thus virtually eliminating seal cracks and also giving improved light output. The importance of attention to detail can be appreciated by considering some of the processes involved in making 140 W sodium lamps.

The cathodes are formed from thoriated tungsten wire coil-coiled on a mandrel. Hydrogen fired "Fernico" alloy lead wires are then welded to the cathode legs. When the hard glass seals have been made on the cathode legs the cathode is cleaned in hydrogen, dipped in emissive coating solution and then hydrogen-fired again.

Exhausting the outer jackets of a batch of type MBF mercury lamps. The operative is sealing off one of the lamps



The arc tube is made by hand bending a glass tube of two-ply construction lined with sodium resistant glass over a former to a U shape and trimming to length. Recently, a machine has been developed which produces these "U" bends automatically. A length of glass tube is then sealed to the apex of the bend for use ultimately in exhausting the lamp. The assembly is washed before pinch sealing the cathode assemblies into the ends of the arc tube. The bend in the arc tube and the pinch seals are then carefully annealed. Before exhausting the arc tube, a dose of sodium in a length of open-ended glass tube is lodged in the tubulation and the lamp is sealed to the exhaust system. During the long exhaust process the lamps are arced several times to ensure that all impurities are removed. The double-distilled sodium is then melted by h.f. heating coils and it runs down into the arc tube.

The lamp is then filled with a spectroscopically pure mixture of neon and argon gas and sealed off. It is important that the sodium is distributed evenly; this is done by arcing the tube to melt the sodium and then shaking it by hand. Starter strips are fixed in position and the tubes are capped. The lamp is then aged in a vacuum flask and tested to ensure that it will strike at a voltage below that likely to be encountered under the most adverse operating conditions. As a final inspection before the lamp is packed it is tested on a high-voltage d.c. supply to check the condition of the gas filling.

A preformed glass inner bulb is diamond-cut to length and the end of the outer bulb flared and annealed. After sealing an exhaust tube to the apex of the outer bulb and etching a "Mazda" trade mark the assembly is annealed and the two bulbs sealed together while rotating on a machine. The flask is then exhausted to a hard vacuum of less than one micron and sealed off. A ceramic cap is cemented in position and the vacuum tested by a spark discharge. The flask is then packed; sodium lamps and flasks are packed separately.

The company's type MA mercury vapour discharge lamps are medium pressure lamps operating in the region of one atmosphere. The more important ones made at Leicester are the 250 W and 400 W lamps. As in the manufacture of all the high pressure discharge lamps which the company makes the human element is of the utmost importance and much depends upon skilful glass working.

The cathode coils are made by winding tungsten wire on a mandrel in two helix sizes. A small pellet of electron emitter material consisting of thorium oxide, barium, and calcium is inserted into the inner helix which is in turn inserted sideways into the outer helix. The assembly is then welded to the two arms of a welded molybdenum "T" piece which has previously been sleeved with glass. The "striking" or auxiliary electrode is made by glass sheathing the middle of a short length of plain molybdenum wire. A special glass is used which has a similar coefficient of expansion to molybdenum.

The next process is to seal the electrode assemblies into the arc tube bulb, which is received from the glass works at Chesterfield shaped like a test tube but with a

General view of the machine for exhausting MA lamps. Different operations are performed upon the lamps to process them as the machine slowly rotates

constriction a little below the mouth. The method used is to puncture the dome of a preformed bulb and seal into it a cathode and a striking electrode. An exhaust tube is sealed on between the two. The open end of the bulb is formed into a dome and the second cathode sealed into position. After inspection the arc tube is pre-exhausted, filled with nitrogen and annealed.

A fabricated glass tube assembly is then sealed to the exhaust tube and a side arm of the assembly dosed with an exact amount of high-purity mercury. Immediately before exhausting the arc tube its ends are painted with liquid platinized paint to reduce heat radiation from the bulb surface behind the electrodes. The arc tubes are sealed to the glass exhaust system on a rotating exhausting, ovening and arcing equipment where they are processed and finally filled with spectrally pure argon gas and sealed off. By inverting the complete arc tube and glass tubing assembly, the arc tube is dosed with mercury. It is then sealed off and detached from the tubing assembly.

The completed arc tube is now mounted between annealed spring steel discs connected by manganese nickel wires and mounted upon a glass stem. This assembly will locate the arc tube in the glass outer envelope of the lamp. A titanium oxide striking resistor and nickel tape connectors are added and the assembly is sealed into the outer envelope at the stem flare rim in a similar way to that used with an ordinary tungsten filament lamp. It is now only necessary to exhaust the outer envelope and fill it with a controlled low pressure of nitrogen to ensure an inert atmosphere and provide the arc tube with adequate thermal insulation. A cap is fitted and the finished lamp is operated at rated watts for an ageing period to ensure stability in service.

Type MAF mercury discharge fluorescent lamps are made on the same production line as the 400 W MA lamps but the arc tubes are dosed with a small quantity of cadmium and sealed into outer isothermally shaped jackets which have been internally sprayed with fluorescent powder, thus adding some red component to the light and improving the colour rendering.

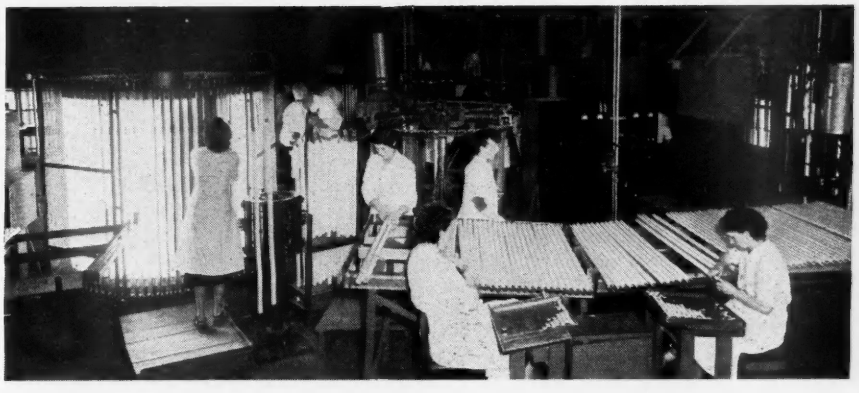
Turning to the high pressure lamps the outer envelope of the type MB lamp is similarly shaped to an ordinary GLS tungsten filament lamp, but it is fitted with a three-pin bayonet cap. It is made in 80 W and 125 W sizes. Owing to the high operating temperatures and pressure of about 8 atmospheres, the arc tubes are made of quartz. It is thus not possible to use a metal lead wire having "matching" characteristics. Lead wire assemblies, incorporating a length of very thin, feather-edged, molybdenum or molybdenum tungsten foil are used.

They are made by inserting the composite metal leads, with quartz spacing strips for twin seals, into quartz tubes and processing the tubes on a specially designed machine. Seal making takes only 30 sec, during which time temperatures in excess of 2,000 deg C are attained. The seals are withdrawn from the machine and the electrodes welded into position ready to be sealed into transparent quartz arc tubes. This is carried out on vertical rotary head sealing-in machines. When both electrode assemblies have been sealed into the body the unwanted pieces of tube, which have hitherto protected the seal leads, are cut away and the arc tube is ready to be exhausted. The arc tube exhaust, mounting, sealing-in and finishing processes are very similar to those used in the manufacture of the medium pressure lamps.

Improved colour corrected MBF lamps are a recent addition to the "Mazda" range available in 80 W and 125 W types. They are almost identical to MB lamps but have a phosphor coating on the inside of the bulb which contributes a red component to the light.

The type ME compact source lamp is a 250 W high pressure mercury vapour lamp for use in optical instruments, etc. It is available in three types and consists of a quartz bulb containing two tungsten electrodes set 3 mm apart, between which an arc burns steadily with a brightness in the region of 20,000 candles/sq cm. This lamp is completely hand-fabricated.

"Mazda" fluorescent lamps are made in 15 W, 20 W, 30 W, 40 W, 80 W and 125 W sizes. Of these the 80 W 5ft lamp continues to be the most popular line in this country and the manufacture of these is completely flow mechanized at Leicester.

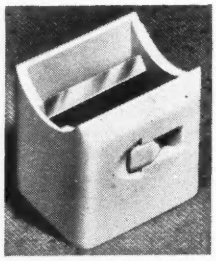


View of part of the continuous flow production line on which "Mazda" 5ft 80 W fluorescent lamps are sealed, exhausted, capped, aged and packed

NEW ELECTRICAL EQUIPMENT

Locking Holder for Light Tubes

A VIBRATION-PROOF " Mazda " lampholder for architectural light tubes is now available from the BRITISH THOMSON-HOUSTON CO., LTD., Crown House, Aldwych, London, W.C.2.



" Mazda " lampholder for architectural light tubes

A thumb-nail catch on the side of the holder locks the lamp socket by turning a cam which prevents the clip holding the lamp peg from opening. This ensures a good contact and the positive retention of the lamp. The socket is locked when the catch is closed.

Moulded in ivory white, the lampholder has a single fixing hole and can be adapted for surface wiring if necessary. The price per pair is 6s 8d.

Oil-Break Switches

Among the latest items of switchgear to be introduced by A. REYROLLE & CO., LTD., Hebburn, Co. Durham, is the type IC27 oil-break switch, which is suitable for operation at up to 11 kV. It has been designed to couple direct to Reyrolle class C switchgear but is equally suitable for use on its own either as an independent unit or for building into switchboards with similar units.

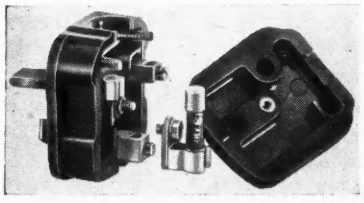
The unit has a normal current rating of 400 A and consists of a switch chamber with a busbar chamber at the back and with current-transformer accommodation and cabling arrangements below. The switch chamber accommodates the main switch together with an independent earthing switch. Both switches are capable of making and carrying for three seconds a current corresponding to 75 MVA at 3·3 kV, 150 MVA at 6·6 kV, or 250 MVA at 11 kV, and the main switch is capable of breaking its rated normal current.

Roller-Towel Dryer

The " Drygiene " electrically heated roller-towel dryer, recently placed on the market by BROMWEST, LTD., 159, Notting Hill Gate, London, W.11, is suitable for both industrial and domestic use and is claimed to keep a roller-towel constantly dry and hygienic. Consisting of a metal wall-fixing cabinet 14½in high, 22in wide and 6½in deep, it incorporates a perforated pivoted roller which houses a 150 W black heat element. To operate the dryer it is only necessary to open the lid upwards, swing the pivoted roller out and slip the roller-towel over it, insert a disinfectant evaporator into holder at the back of the case and then push the roller back into position and close lid. Finished in cream enamel, the dryer has a voltage range of 200/250 V a.c. or d.c. and it is priced at £4 6s 8d plus £1 8s purchase tax in the United Kingdom. Disinfectant evaporator refills cost 7s 6d a dozen.

Fused Plug

Improvements in the 13 A three-pin fused plug manufactured by NETTLE ACCESSORIES, LTD., Harper Road, Wythenshawe, Manchester, have been announced. The fuses are now retained in silver plated phosphor bronze clips and the terminal pins are removable for quick and easy wiring. The plug conforms to B.S. 1363 and is available in both brown and cream. The retail prices are 39s and 43s 8d per doz respectively.



Nettle 13 A three-pin fused plug

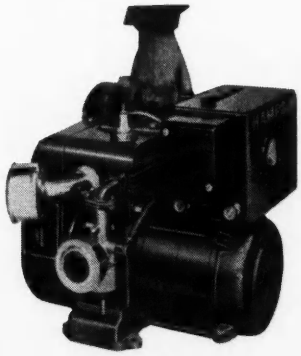
Reyrolle type IC27 oil-break switch

Portable Power Plant

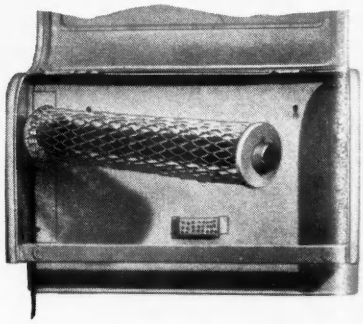
Of special interest to farmers and country garages, the " Hampson " light-weight petrol-engine driven d.c. battery charging and a.c. mains voltage plant, has recently been developed by HAMPSON INDUSTRIES, LTD., Bull Lane, Greets Green, West Bromwich.

The 500 W portable d.c. model will charge up to twenty 6 V or ten 12 V batteries at 4 A and is capable of charging up to 40 A. Larger models are available up to 1½ kW.

The a.c. mains voltage models are available in two sizes, 500 W and 1½ kW, 220/240 V single-phase 50 c/s. They comprise a flange mounted generator close coupled to a high-speed petrol engine complete with a small compact switchbox mounted on cushioned feet directly on the generator. Equipped with battery charging cut-out, ammeter, sliding field regulator and output terminals, these self-contained units are ready for immediate application. A strong tubular steel handle is conveniently fitted for easy carrying purposes. The models are finished in a pleasing grey colour and cost from £60.



" Hampson " portable battery charger



" Drygiene " roller-towel dryer

VIEWS on the NEWS

By REFLECTOR

WHEN the British Electricity Authority and Area Boards took over the electricity supply industry a minor embarrassment was the existence of privileged classes of employees. It had been the custom of some of the former undertakings to allow their employees special rates for their electricity and very favourable terms for electrical equipment. Naturally when these employees came under the same employers as others who had not enjoyed preferential terms one of two courses had to be taken: either the privileges must be extended to all or they must be withdrawn. Very wisely withdrawal was decided upon but those affected were compensated to some extent. Now it is strange to find that in the North Western area an attempt has been made to revive the practice of cheaper electricity for employees because, it is said, miners enjoy cheaper coal and railwaymen have travel concessions. The District Joint Advisory Council has rejected the proposal as likely to induce public resentment.

* * *

In proposing his amendment to the Electricity Reorganization (Scotland) Bill (which the Government accepted) changing the name of the British Electricity Authority to "the Central Electricity Authority," Cdr. Donaldson said that the alteration would end the confusion caused by the sharing of the same initials by the Authority and British European Airways. No doubt it will, but the Authority will still have to share its new initials with, for instance, the Cinema Exhibitors' Association, the Christian Endeavour Association and (overseas) the Canadian Electrical Association—if that matters.

* * *

While the House of Commons was debating commercial television I was very interested to read in the *Edison Electric Bulletin* a forecast of the probable lines of a two-hour multi-network television programme which is to be put on by Mr. David O. Selznick, the eminent film producer. This programme, scheduled for Sunday, 24th October, is a part of the celebrations in connection with "Light's Diamond Jubilee" (see my note of 30th April). It "will be aimed at the largest audience ever to witness any show in any medium in the history of entertainment." Mr. Selznick has stated that the programme will not be a variety show:—

> "He sees it as one with dramatic unity and format that will present an interpretation of the spirit and meaning of American life, both in the past 75 years and in the future, with the significance of electrical living as an integral part."

Maybe E.D.A. will be able to do something like this in two or three years' time.

* * *

There seems to be a certain amount of elasticity in some of the charges imposed by Electricity Boards. In recent months I have read of several instances in which, as a result of pressure, concessions have been made in certain cases. I now see that at a meeting of the Stourbridge Chamber of Trade it was stated that representations had been made to the Midlands Electricity Board about the electricity charges of two members and in the case of one of them a reduction of about 22½ per cent had been secured. The Streets Committee's report submitted at a meeting of the Aylesbury Borough Council "revealed" that before new street lighting charges were agreed to the Council's officers succeeded in getting the Eastern Electricity Board's original tender reduced by over £641.

* * *

Writing to *The Times* on the subject of women graduates (in business and the home) the Rev. Herbert Livesey says:—

> "In this mechanical era probably all jobs are becoming monotonous—the typewriter, the telephone, the adding machine, and the internal combustion engine make life as drab as do the vacuum cleaner and the washing machine, and life is what we do with our leisure."

He goes on to say that he knows "many women who seem to be competent to find a home a soul-absorbing job." There are, however, women who maintain that without vacuum cleaners, washing machines and other aids housework is a soul-destroying job. It seems strange to hear the epithet "drab" applied to modern labour-saving appliances. Mr. Livesey appears to advocate work for work's sake.

* * *

I have frequently referred to the use of electricity in fishing and the control of piscine movements. Such cases as I have mentioned have involved the use of current to stun the fish or deflect them into or away from certain channels. But in 1884—seventy years ago—electricity (in the form of light) was being employed by fishermen. In the 17th May issue of the *Electrical Review* in that year there appeared an article on trials of a system installed in the steamship *Tilly* consisting of a high-speed "Invincible" engine (J. & H. Gwynne) driving a "Phœnix" dynamo (Paterson & Cooper). From the dynamo there ran flexible leads of specially stranded copper wire encased in rubber tubes. These passed round a wooden drum, which took up the slack. There was a lowering winch and the lamp (said to be of 15,000 candle power) could be lowered to a depth of 10 fathoms. The *Review* considered that

> "the idea of using the electric light for fishing purposes is possibly capable of great development before long, it being well known that a very powerful electric light has a strangely fascinating effect on the finny tribes, which flock in great numbers towards the light centre and can then be easily surrounded with a net."

* * *

Two correspondents have sent me a cutting from the *Daily Mail* of the following news item:—

> "Blaze in an electrical transformer 116ft high was put out by firemen at Fulham power station, London."

They say that bearing in mind the relationship between transformer output and physical dimensions, it would appear that the unit referred to has a very large output and occupies little or no floor space. They ask "Was it perhaps installed inside one of the main chimney stacks—hence the fire?"

PERSONAL AND SOCIAL

News of Men and Women of the Industry

THE Minister of Fuel and Power has appointed **Sir Lawrence Bragg,** O.B.E., M.C., F.R.S., and **Professor H. W. Melville,** F.R.S., to be members of his Scientific Advisory Council from 1st September, 1954. The Council was set up in 1948 to advise the Minister on the scientific aspect of his statutory duties. Sir Lawrence Bragg has been Fullerian Professor of Chemistry, Royal Institution, since 1953, and Resident Professor and Director of the laboratories of the Royal Institution since January. He was previously Cavendish Professor of Experimental Physics at Cambridge.

At the annual general meeting of the Institute of Export, **Mr. Leslie C. Gamage,** M.C., vice-chairman and joint managing director of the General Electric Co., Ltd., was re-elected president. This will be Mr. Gamage's twelfth year in that office. **Mr. D. Maxwell Buist,** export director of B.E.A.M.A., retired from the position of chairman of the Council, which he has held for three years. He is succeeded by **Mr. J. P. Ford,** M.A., managing director of National Oil Engines (Export), Ltd., Associated British Oil Engines (Export), Ltd., and Brush Export, Ltd. At a Council meeting last week Mr. Buist was presented with a Parker "Magnetix" desk set in appreciation of his three years' service as chairman.

Mr. L. J. Attewill, A.M.I.E.E., has been appointed a director of the Electrical Apparatus Co., Ltd. He went to the company as an apprentice in 1930 and after completion of his practical training he joined the technical staff, becoming head of the Automatic Control Gear Department in 1938. Since 1949 he has been assistant sales manager, technical organizer and a member of the Management Committee. Mr. Attewill was the secretary of the electric motor control gear productivity team which visited the United States in the winter of 1949-50. In his new appointment he will be responsible for production matters.

Mr. J. Walton, joint managing director of Thos. W. Ward, Ltd., completed fifty years' service with the company on 14th March and at a dinner recently given in his honour at the Royal Victoria Hotel, Sheffield, he was presented by the directors with a silver rose bowl. Mrs. Walton received a diamond spray brooch. The presentation was made by Mr. Ashley S. Ward, president of the company.

At Manchester University on 12th May, the honorary degree of Doctor of Laws was conferred upon **Sir Arthur P. M. Fleming,** a member of the University's Court of Governors and director of research and education, Associated Electrical Industries, Ltd., and upon **Sir Joseph Hallsworth,** chairman of the North Western Electricity Board.

Mr. N. R. Elliott, O.B.E., M.A., M.I.C.E., M.I.E.E., chairman of the South Eastern Electricity Board, has been appointed a Justice of the Peace for Hove.

Above: Monsieur P. Gaigé (France) with Mr. R. A. McMahon, hon. secretary, British National Committee, C.I.G.R.E. Left: At one of the tables at the C.I.G.R.E. gathering—Mr. J. R. Beard, president, British Electrical Power Convention (right) with Mrs. Beard (left) and Mr. and Mrs. H. S. Pocock

Sir Wavell Wakefield, M.P., has been appointed president of the Electric Vehicle Association of Great Britain, Ltd., for the year 1954-55. Other officials appointed at the Association's annual meeting were:—Chairman, Mr. J. Wilkie, Chloride Batteries, Ltd., Manchester; vice-chairman, Mr. H. W. Heyman, B.Sc., M.I.E.E., director, Smith's Delivery Vehicles, Ltd., Gateshead-on-Tyne; hon. treasurer, Mr. N. Hindle, Hindle, Smart & Co. Ltd., London.

Mr. E. G. Batt, who recently retired from the position of director of the British Refrigeration Association, has been appointed a director of Marco Refrigerators, Ltd.

Left: Delegates to the International Conference on Large Electric Systems (C.I.G.R.E.), Paris, dancing after a reception at the Cercle Interallié last Friday

At the annual general meeting of the Aluminium Development Association on 23rd April, **Mr. R. T. Priestman,** managing director of T. J. Priestman, Ltd., was elected president for 1954-55. Mr. Priestman, who has been a member of the Institute of Metals for over thirty years, joined the Council of the A.D.A. in 1947, as the representative of Alar, Ltd. He is a member of the Council (and late chairman) of Alar, Ltd., and chairman of its Technical Committee and also a Council member of the Federation of Light Metal Smelters. The new vice-president of the Association is **Mr. R. D. Hamer** (Aluminium Laboratories, Ltd.). **Mr. H. Goodwin** (Birmetals, Ltd.) was appointed chairman of the Executive Committee of the Association in succession to Mr. G. W. Lacey.

Mr. F. W. Joyce has been appointed manager of the household appliance and domestic equipment department of the Liverpool Branch of the General Electric Co., Ltd., under the general managership of Mr. G. L. Butler. Mr. Joyce joined the G.E.C. in 1933 and served an apprenticeship at Witton Engineering Works and Magnet Works, Birmingham. After war service, including four years as a prisoner of war, he returned to the G.E.C. in 1946, and was appointed technical sales engineer in the Domestic Equipment Department. In this capacity he represented the company on the Technical Committee of the B.E.A.M.A., Domestic Cooker Section.

Mr. E. W. Jones, manager of the Central Sub-Area of the South Wales Electricity Board, was installed as High Constable of Miskin Higher at the Aberdare Magistrates' Court on 12th May. This office is said to date from 1285.

Bailie Bruce Russell, who is engineer and manager for Johnson & Phillips, Ltd., in Scotland, has been appointed a magistrate of the City of Edinburgh. He is also a director of J. & P.'s associated company, Aurora Lamps, Ltd.

The maritime business of Marconi's Wireless Telegraph Co., Ltd., which has hitherto been handled by the Central Division, is now taken over by a newly formed Maritime Division. In order to organize this, **Mr. G. R. Tyler** has relinquished his position in the Central Division and has been appointed manager of the Maritime Division. **Mr. R. H. Deighton** succeeds Mr. Tyler as manager of the Central Division. **Mr. J. Watt,** B.Sc. (Hons.), D.I.C., has been appointed chief engineer, Maritime Division, technically responsible to the engineer-in-chief, and retains his present responsibilities for marine development. The Services Equipment Division will henceforth be known as the Radar Division. **Mr. H. J. H. Wassell,** O.B.E., B.Sc.(Hons.), has been appointed chief engineer, technically responsible to the engineer-in-chief and maintains his present responsibilities for radar development.

Mr. R. E. Burnett, M.A.(Oxon.), A.M.I.E.E., A.Inst.P., has been appointed assistant to the general manager of Marconi's for special duties. He will retain his responsibilities as manager of education and technical personnel and will remain principal of Marconi College. Mr. Burnett is also officially confirmed as adviser on technical staff matters to the associated companies at home and overseas. In view of Mr. Burnett's additional responsibilities the following appointments have been made:— **Mr. E. R. L. Lewis,** M.A., A.M.I.E.E., has been appointed deputy manager, education and technical personnel; **Mr. R. G. Hulse,** B.Sc.(Hons.), has been appointed deputy principal of Marconi College and director of studies; and **Mr. J. Lindsay Scott,** Associate I.E.E., has been appointed chief of technical personnel recruitment.

Mr. K. S. Estlin, O.B.E., M.C., T.D., Associate I.E.E., has been appointed manager of the Ediswan London district office. Mr. Estlin completed an apprenticeship course with the Metropolitan - Vickers Electrical Co., Ltd., at Trafford Park in 1930 and subsequently he served on the staff of the company in the Marine Department at the works and in the London district office until mobilization in 1939. On release from the Forces, Mr. Estlin rejoined Metropolitan-Vickers and, following a refresher period at the works, was appointed manager of the Plymouth office. He resigned from that post in 1949 to join Uni-Gun Lubricating Equipment, Ltd., and for the past three years has been managing director of that company.

Mr. K. S. Estlin

Mr. R. B. Potter has been elected chairman of the Water-Tube Boilermakers' Association and **Mr. J. B. Woodeson,** O.B.E., becomes vice-chairman.

Mr. W. F. Stones, A.R.I.C., station chemist, Dunston, has been appointed divisional chemist to the North Eastern Division, British Electricity Authority, with effect from 1st June next, in succession to **Mr. W. S. Coates,** who retires early in June.

Mr. E. H. Boyce, A.M.I.E.E., A.M.I.Mech.E., has been appointed power station superintendent at Kirkstall power station, Leeds, Yorkshire Division, B.E.A., with effect from 1st May. Mr. Boyce has been deputy station superintendent at Kirkstall power station and his previous appointments include operation superintendent, Poole power station (1950-53), and shift charge engineer, Meaford power station (1947-50).

The Minister of Fuel and Power has appointed **General Sir Frank E. W. Simpson,** K.C.B., K.B.E., D.S.O., to be a part-time member of the Eastern Electricity Board.

Sir Leonard Browett has been elected to the board of Telephone Rentals, Ltd.

Mr. F. N. Pardow has joined George H. Scholes & Co., Ltd., as assistant sales manager.

The long and close association of the University of Cambridge with the **Cambridge Instrument Co., Ltd.,** was signalized on 28th and 29th April when the company held an " at home " at its works in Cambridge, to which invitations were issued to the professors, teaching staffs, research students and senior men taking science subjects in the University. During the two days over 700 visited the works, and were entertained to tea. All sections of the factory and the research departments were open for inspection, and various demonstrations were given.

The Amateur Dramatic Society of the Sports Club of **Siemens Brothers & Co., Ltd.,** Woolwich, presented the Siemens Players in " The White Sheep of the Family," by L. du Garde Peach and Ian Hay, at the Sports Club Hall in Charlton Park Lane, on 1st and 8th May. This comedy was much appreciated by the audiences, which included Mr. F. W. H. Shaw, cable branch manager, Mr. A. W. Newbold, factory manager, and Mr. W. T. Pope, labour manager.

The **Lancashire and Cheshire Radio Industry Golfing Society** held a competition at the Ormskirk Golf Club on 28th April for the Founder's Trophy, the winner being Mr. G. A. Proffitt. The Society also played the usual match with the **Yorkshire Radio Industry's Golfing Society** at Moortown Golf Course on 12th May, which resulted in a win for the Lancashire and Cheshire Society by three matches to two, with one halved.

The annual **Manchester-Liverpool Electrical Trades Inter-City Golf Match** for the J. H. Farthing Trophy was played at Mere Golf and Country Club on 12th May. Of the twelve matches played, Manchester won seven, Liverpool four and one ended all square; Manchester thus retain the trophy. The captains, Mr. N. L. Allen (Manchester) and Mr. S. R. Gee (Liverpool), presented four tankards to the two competitors on each side who

won their matches by the biggest margins. These were Mr. A. E. Hamlett and Mr. B. W. Simpson (Manchester) and Mr. G. S. Butler and Mr. D. E. Morris (Liverpool). The trophies were presented by Mr. J. A. Emery. Arrangements for the match were made by Mr. F. J. Burns (Cryselco, Ltd., Liverpool) and Mr. E. G. Taylor (G.E.C., Manchester).

The third annual Birmingham Electric Club scholarship, which is open for award to part-time students in the Electrical Department of the College of Technology, Birmingham, has been awarded to **Mr. R. T. Sartain,** who is employed as an estimator by the General Electric Co., Ltd., at the Witton Works, Birmingham.

At the Victoria Hotel, Bradford, on 8th May, the **Bradford Engineering Society** held its annual dinner. Deputizing for Mr. C. M. Cock, general manager of the traction department, English Electric Co., Ltd., who was away on business in Argentina and was to have been the society's chief guest, Mr. John Parker, general manager of the English Electric Co. at Bradford, proposed the toast of "The Society." The other speakers were the Lord Mayor of Bradford, the president, Mr. W. Marshall, Mr. J. Smith, Mr. A. Wightman (president, Huddersfield Engineering Society) and Mr. J. T. Empsall.

OBITUARY

Col. H. J. Wellingham.—The death occurred on 5th May, at the age of fifty-nine, of Colonel H. J. Wellingham, M.C., T.D., manager of the Post Office London Central Telegraph Station. Before the station was taken over from Cable & Wireless, Ltd., Col. Wellingham was manager of the London branches of Cable & Wireless, Ltd., which included the central telegraph station from which all telegrams to and from this country pass by landline between the four wireless stations and the cablehead in Cornwall. During the last war Col. Wellingham served with the R.E.M.E. in Tunisia and in 1944 was seconded from the Army to establish the new post of Press liaison officer of Cable & Wireless, Ltd. He was a familiar figure at functions of the Bati-Wallahs' Society, of which he was president for the years 1947 and 1948.

Mr. J. W. Roffey, London area manager of Sangamo Weston, Ltd., was killed when motoring to London after a visit to the British Industries Fair, Birmingham, on 12th May. Mr. Roffey, who was forty-five years of age, had been with the company since 1924 when he was first employed in the Assembly and Testing Departments. After gaining experience in all production departments, he became contracts engineer in 1936. During and after the war he specialized largely in instrumentation for all types of aircraft and played a considerable part in the development of many types of electrical instruments. He was appointed London area manager in 1950.

Mr. J. Harris.—The death occurred on 21st April, at the age of fifty-four, of Mr. Jacob Harris, H.M.V. household appliances representative for the Midlands for E.M.I. Sales & Service, Ltd. He had served with the company for eighteen years.

PARLIAMENTARY REPORT

WHEN the Atomic Energy Authority Bill came up for second reading in the House of Lords last week the Marquess of Salisbury (Lord President of the Council) said that the Atomic Energy Authority was given power under Clause 2 to produce and dispose of "articles" required for the use of atomic energy and under Section 18 (2) of the Atomic Energy Act, 1946, the reference to "articles" included electricity. This, read together with Section 23 of the Electricity Lighting Act, 1909 (amended by the Electricity Act, 1947), meant that the Authority could, so long as it did not make electricity generation its prime business, produce electricity as a by-product of its undertaking and do any necessary work to supply electricity to the public.

This power to supply electricity as a by-product would be similar to that possessed by some other major undertakings. But he wished to make it clear that the Government certainly did not intend that the Authority should use this power so to generate electricity except as a by-product of the manufacture of fissile material or as a product of experimental power stations; nor was it intended that the Authority should in any case supply electricity to the public. It was not in any way meant to compete with the Electricity Boards. The precise arrangements to be made between the Authority and the electricity authorities must inevitably take time to work out, but the broad policy would be that the Authority would not construct transmission or distribution lines outside its own premises, and would offer to the Electricity Boards any electricity which it generated and which might be surplus to its own internal requirements.

Viscount Samuel, supporting the Bill, said that the industry arising out of atomic energy might prove to be one of the key industries of the world. For Britain, in particular, it might be of great economic moment, and it was right that its development should be proceeded with actively here, for the whole of what was now almost a world-wide enterprise arose out of British scientific discovery—the discovery of the atom by J. J. Thomson and Rutherford at the Cavendish Laboratory, Cambridge.

Viscount Waverley emphasized the importance of providing for more and more devolution to industry of work in connection with the development of atomic energy. He believed there was a great future for this country not only in the organization of power stations, but also the devising and manufacture of all sorts of plant and equipment for the application of atomic energy.

Lord Glyn thought it was probable that within fifteen years the railways of this country would be operated by local power stations of a breeder type. That would obviate the wasteful consumption of coal in steam locomotives. In coal production we were nearly at the limit of what could be obtained from the mining industry, and if the electricity projects now under consideration were carried out the 46 million tons of coal a year now devoted to conversion to electrical energy would be increased to 60 million tons, and it did not look as if that amount would easily be found.

Viscount Falmouth said he wished he could feel happy about some of the statements made about the development of nuclear energy for power purposes. The public was being led to believe that some vast development was about to come which would make a great change in the generation of power. They knew that the station activated by thermo-neutrons would cost about twice as much as an ordinary power station and that its thermal efficiency would be only 20 to 25 per cent, whereas in a standard steam station it was now in the neighbourhood of 35 per cent. They did not know accurately the cost of uranium fuel, but he had seen figures quoting from £5,000 to £20,000 a ton. Nobody knew the real market price of uranium metal or the quantity used to generate a kilowatt. In view of the many variables all of the estimates of the cost of power delivered to the grid were

unreliable, except to show that the cost of power generated by this process at present would be considerably higher than that by the coal-fired stations. The latter burnt the worst form of coal that nobody else would use. With the extension of mechanization at the coal face the percentage of fines had been increased, in many instances by as much as 20 per cent, and the only way to dispose of this type of coal was on the grates of power stations. He felt that unless the advocates of large scale atomic power generation in the United Kingdom were able to bring forward schemes whereby the cost of energy delivered to the grid would be considerably lower than the coal cost, there was little chance of this country seeing any big development in the next fifty years. But it was a different matter overseas, where there seemed to be a great opportunity for power stations operated by nuclear energy in many areas remote from coal and oil supplies. Therefore he welcomed that part of Clause 2 of the Bill which enabled manufacturers and consulting engineers to be brought into the picture.

The Bill was read a second time.

Telephone Developments

Mr. Gerald Williams called attention to the need to improve the telephone service, and moved " That this House, while appreciating the considerable improvement that has been made in connecting new subscribers, urges the Government to recognize the importance of a comprehensive and efficient telephone service to the trade and industry of the country; and, consistent with other demands for capital expenditure, to take every possible step to reduce the delay in obtaining calls and to improve the facilities given."

After debate, Mr. Gammans, the Assistant Postmaster General, said that the Government was happy to accept the motion in word and spirit. There had been a steady improvement in quality. In 1946 the speed of an answer on a manual exchange was 10 seconds, and it was now down to seven; on automatic exchanges the time had been reduced from 10 to 5 sec. Experiments were being made with a device to give an exchange supervisor warning that a particular caller had been waiting for some time. In 1946 the percentage of calls lost in dialling was 12, but it was now down to 2¼. A " leave word " facility had been in operation in the United States for some time, but was new to this country. By it if a caller was not available a message could be left for him to ring the personal call operator at the originating exchange without extra charge.

Another new service, which had also been in operation in the United States, provided that if an operator could not get a person being called the first time, an effort was made to find him at various places where he might be. There was no extra charge for that. The policy of the Post Office was to convert every telephone exchange into an automatic exchange, and had it not been for the war they would have done it long ago. The number of subscribers still using manual exchanges was 1,500,000 compared with 4,500,000 using automatic exchanges.

The Dollis Hill establishment had a high record of original research, and a good percentage of the equipment was now being used for the new transatlantic cable now being laid down with British equipment.

The motion was agreed to.

London's Trolley-Buses

Mr. Nabarro asked the Minister of Fuel and Power what estimate he had formed of the additional fuel oil consumption that would be entailed in a full year consequent upon the decision to replace approximately 1,800 London electric trolley-buses by diesel-powered vehicles, and of the effect upon the load factor of power houses in the Greater London area following diminution of the road traction electricity demand, notably at off-peak hours.

Mr. Joynson-Hicks, the Parliamentary Secretary, said that the additional consumption would be about 28,000 tons of diesel oil. The effect on the electricity load factor in Greater London would be negligible.

Mr. Nabarro asked if it was judicious to swing over from the use of very low grade indigenous fuel to imported fuel. In view of the very large investment in power houses was not this decision inimical to the national interest ?

Mr. Joynson-Hicks said he did not think it was.

Asked by Mr. Teeling if the decision in London was not bound to have an effect on the provinces, Mr. Joynson-Hicks said it certainly would, but the situation in London was different from anywhere else in the country because nearly 50 per cent of the trolley-bus electricity was drawn from the London Transport Executive's power house. Owing to the demands on this generating plant for railway traction the load factor was improved by the removal of the trolley-buses.

Colour Television

TWO possible approaches to the problem of providing a colour television system compatible with the present British 405 line monochrome system were demonstrated in London last week by Marconi's Wireless Telegraph Co., Ltd. The first was an adaptation of the American N.T.S.C. system in which an extra signal carrying the colour information is transmitted within the same band as the existing monochrome signal. This is achieved by a process known as frequency interleaving and the system has the advantage that no extra bandwidth is required. However, it suffers from the disadvantage that the colour signal interferes with the black and white signal, producing a " crawling dot " pattern on the screens of receivers.

The second system that was demonstrated is similar to the above mentioned N.T.S.C. system except that the colour signal is now transmitted outside of the band occupied by the black and white signal. Although this " wide-band " method requires up to 50 per cent more bandwidth than the first system it gives a better colour picture and avoids the interference.

Demonstrations were given of both colour films and " live " subjects on the two systems and with various changes of bandwidth. The audience was also able to compare the colour pictures with monochrome pictures produced by the same signal. Two alternative methods of presenting the colour pictures were shown side by side: the R.C.A. tri-colour cathode ray tube and a triple projection unit using optical superimposition of the images from three small cathode ray tubes with coloured screens. In our opinion the former gave the better picture.

Finally, the live pictures were produced by an experimental colour camera using only two pick-up tubes as opposed to the three tubes used in the R.C.A. colour camera. One tube in this new camera produces a high definition monochrome signal, while the other produces blue and red colour-component signals; the green primary colour component is later derived by subtracting the blue and red signals from the monochrome signal. This camera is very well adapted to the N.T.S.C. type of system.

Electricians' Strike

We were informed at the time of going to press that there had been no alteration in the position at the Greenford and Cadby Hall establishments of J. Lyons & Co., Ltd., where 180 electricians are on strike. We stated last week that the strike was called because the company had engaged a supervisor who was not a member of the Electrical Trades Union. Actually the supervisor has been in the company's employment for twenty years and was a member of the Union until his promotion to his present position. The strike occurred when he was transferred to Greenford.

The company says that its policy is to encourage trade union membership, but it cannot agree that supervisors should necessarily be members of the E.T.U.

The Scottish Bill

Decision to Change Name of the B.E.A.

LAST week the Electricity Reorganization (Scotland) Bill was considered in Committee of the House of Commons.

On Clause 1 (Transfer of the Functions of the Minister of Fuel and Power to the Secretary of State) Mr. Nabarro said it was still obscure as to who was the responsible authority for the overall duty of co-ordinating fuel and power policy, embracing coal, gas, electricity, fuel oil and the remainder. They were creating a situation whereby the Secretary of State for Scotland would be responsible for the South of Scotland Board for electricity generation and distribution, and the Minister of Fuel and Power would be left responsible for the other nationalized fuel industries—coal and gas.

Mr. L. W. Joynson-Hicks, Parliamentary Secretary to the Ministry of Fuel and Power, said there was nothing in the Clause or in the Bill which could curtail the Minister's powers and duties of co-ordination. What, in fact, were transferred were certain specific powers with regard to electricity supply.

Mr. Palmer pointed out that under the 1947 Act the chairman of the North of Scotland Hydro-Electric Board was made a member of the British Electricity Authority, whereas, under the present Bill, it was proposed to remove him. That link with the Ministry of Fuel and Power was removed by the Bill.

Mr. Joynson-Hicks said that was only a link, or, in terms of electricity, a cycle, but it did not affect the principle at all, and co-ordination could be carried on without it.

The Clause was agreed to.

On Clause 2 (Establishment and Functions of the South of Scotland Electricity Board) Mr. McNeil moved an amendment to provide that " among such persons shall be one qualified as having experience of, and shown capacity in, the organization of workers." He said the amendment sought only to ensure that the Authority should conform to a pattern which had been set by other authorities.

Mr. James Stuart, the Secretary of State for Scotland, said that the Bill followed the design or precedent of the North of Scotland Board, which had worked so well in practice. But he was quite prepared to consider the matter again. They did not want too big a Board, and he was hesitant about laying down hard and fast rules. Obviously, whoever had to deal with the appointments would choose from people thought to be qualified and suitable. But he would look at the point again.

On this understanding, the amendment was withdrawn.

Divided Responsibility

In a brief debate on the Clause, Mr. Palmer said that it did not give a unified Scottish electricity authority; it gave to the country the worst of both the worlds, because they were not to have a unified system for Scotland, nor were they to continue with the highly successful system of bulk generation and transmission which they had had since the passing of the 1926 Act for the whole of England, Wales and Southern Scotland. It was his contention that the electricity generation problems of Southern Scotland were precisely similar to those of the rest of the United Kingdom, with the exception of the North of Scotland, where it was granted that there was a special case. The Clause went to the root of the mischief of the Bill itself. It broke up at the Border, in the most arbitrary way, the unified system of the grid, and no technical justifications had been advanced for this change. If the Clause had stopped short, as it could have done, at amalgamating the South West Scotland Board with the South East Scotland Board, that would have been sound. He was not suggesting that in future it would be impossible, under the Clause, to transmit electricity across the Border, but it certainly did mean divided responsibility.

Mr. Woodburn feared that, as a result of the Bill, Scotland would have to pay more for electricity in the long run.

Mr. J. Henderson Stewart, Joint Under Secretary for Scotland, said that the Bill maintained the independence and integrity of the North of Scotland Hydro-Electric Board, and it was the Government's firm intention to do that. Equally, the Government thought it right that there should be a Southern Board with the same kind of independence. He could assure Mr. Palmer that it was made abundantly clear under the Bill that the South of Scotland Board might export to the B.E.A., and that the B.E.A., alternatively, could export to Scotland, as happened now. From the point of view of day-to-day administration nothing would be altered. The Government claimed that whereas there was formerly divided responsibility in Scotland, there would now be unified responsibility. Whereas now the Secretary of State was responsible for Northern but not Southern Scotland, he would, under the Bill, be in future responsible for both. That was plain common sense and good administration.

The Clause was agreed to.

Change of Title

On the First Schedule, Commander Donaldson moved an amendment to change the name of the British Electricity Authority to the Central Electricity Authority, as from 1st April, 1955. He said his reason for proposing this change was that the functions of the Authority in relation to the South of Scotland District would be transferred to the new South of Scotland Board, and there would be a complete change of authority. Subject to certain physical links with Scotland, which would remain, the powers and duties of the British Electricity Authority would be confined to England and Wales, so that the title of the British Electricity Authority would no longer be appropriate.

Mr. Joynson-Hicks: " The Government are happy to accept the amendment."

Mr. McNeil said he was very interested in this sudden decision to accept the amendment. They would be in a very curious position; they would have a United Kingdom Ministry of Fuel and Power and they would have answerable to it an English Authority, but, of course, it was not really an English Authority because it had a role in relation to Wales. He would have thought it would have been more reasonable in this experimental period to leave this great organization, the B.E.A., with its name, instead of having this anonymous, bureaucratic, undescriptive title. More than eight words were necessary to explain the Government's anxiety to take this step.

Mr. Palmer took the same point of view and asked whether there had been any consultation with the B.E.A. Did it like this change?

Cmdr. Donaldson said that notice of the amendment was given as long ago as 29th March.

Mr. Joynson-Hicks said he had not intended to be discourteous. He could assure Mr. Palmer that the B.E.A. had no objection to the change of name. It would not be until the Bill was passed that the Authority would become the Central Electricity Authority.

The amendment was agreed to.

Mr. Palmer moved an amendment to compel the three proposed authorities to act jointly and collectively in the matter of wage and salary bargaining machinery. The general effect of the amendment would be, he said, in the electricity supply industry to preserve unaltered the existing collective bargaining arrangements on a national United Kingdom basis.

Mr. James Stuart said he was willing to accept the amendment, which was agreed to.

The Committee stage was concluded.

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Electrical Films

I WOULD like to offer the following comments on Mr. Franklin's remarks in connection with my article on "Electrical Films."

1. If one consults a catalogue of the better known screen makers it will be observed that in the majority of cases the width of the screen exceeds the depth by 1ft, i.e., 60in by 52in being the common size. Whilst I have seen screens advertised for sale with dimensions of 8ft by 6ft, and in fact have used them, they are not so generally used as the 6ft by 5ft already mentioned. My own society's screen is 8ft by 7ft.

2. Mr. Franklin is quite correct regarding the sound track which I agree cannot be replaced if it has been poorly recorded. Bad printing is another matter.

3. I quite agree that it would be very nice if we could have operators trained as Mr. Franklin suggests, but the job in question does not warrant the salary that would be necessary if the individual had all the qualifications listed. I do not know what experience Mr. Franklin has had in these matters, but mine, which is rather considerable, has always been that the firms willing to pay a tradesman's wage can usually be relied upon. The electrician is the obvious choice as he is in a far better position to train himself in the knowledge of acoustics, electronics, etc., than any other kind of tradesman.

I heartily concur in Mr. Franklin's remarks concerning the amateur. Unfortunately the type of show referred to in my article does not usually fall to the amateur.

Edinburgh. T. B. SANSOM.

Electric Blanket Accidents

MR. W. N. LAVIS in his letter regarding electric blankets (*Electrical Review*, 30th April) suggests that safety lies in using a low voltage. It is, however, wrong to assume that mains voltage blankets are more dangerous than low voltage ones. The circumstances in which an electric blanket is used are unlikely to give rise to risk of shock. The main risk is that of fire and is generally caused by arcing at loose connections or broken wires or by hot spots where element wires touch or cross connection wires. The higher currents present in l.v. blankets increase the fire risk although the risk may be mitigated because the conductors are mechanically stronger.

I believe that the risks of fire developing from an initial burn cannot be great if the blanket is smothered with bed clothing but even the smallest burn near inflammable material is frightening.

The secret of safety lies in the use of the best materials and careful workmanship. Wool substitutes and ordinary cotton materials are cheap but much more inflammable than wool or "proofed" cotton. Also it is important to secure all wires, connections and element runs so that they cannot become displaced.

It is surprising that whilst most manufacturers are fully aware of the need to anchor the flexible lead securely to the blanket and by reinforcement to spread the strain over a wide area, a most inadequate anchorage is provided at the switch or control. These accessories need to be very robust. It is not uncommon for some types to break even if trodden upon with soft slippers and the small cover screws and nuts easily come undone. There is something to be said for the detachable lead which is used with the l.v. blankets; it not only relieves the flexible of all strain but the control can be safely situated on the bedside table and not dangling on the floor.

It should, however, be realized that the inevitable folding and pulling to which blankets are subjected, even when used with reasonable care, impose severe strain upon the internal wires and the flexible leads, and for this reason manufacturers ought to sell an annual service with each blanket to ensure that it is examined and, if necessary, repaired before each winter season.

Perhaps there is greater security in the use of an electrically heated mattress, or an attachment to a mattress, which cannot be folded or ill-treated in quite the same manner as the loose blanket. What do your readers think?

Shoreham, Sussex. H. HOBBINS, A.M.I.E.E.

Hydraulic Constant Speed Drives

REFERRING to the letter from Mr. P. J. Daglish, A.M.I.E.E., in your issue of 7th May, the authors of "Aircraft Electrical Machines" had actually in mind the gear to which he refers.

The passage which Mr. Daglish quotes expresses no opinion as to the merits of the gear, for the reason indicated, i.e., that as far as the writers were aware it was only employed in certain American military aircraft and insufficient information was available regarding its operational behaviour. Technical details of its operation and construction are, however, well known to the authors and the news that it is now being manufactured in this country is very interesting.

Coventry. L. J. CLARK.

Electricity Charges

THE figures of unit charges given by "Cave Canem" last week confused the issue because they relate to one component only of the tariff and not to the total charge.

In support of the statement made by "Reflector"—that the average price of electricity for industrial purposes has risen only by 68 per cent between 1938–39 and 1952–53—readers may be interested to know that in Guildford, to which "Cave Canem" refers specifically, the increase in price for industrial supplies during the same period was 56 per cent. The average increase in Guildford for all classes of consumers was 59 per cent.

Hove, Sussex. A. L. BURNELL,
Secretary,
South Eastern Electricity Board.

Export Value and Volume

Putting the value of exports of electrical machinery, apparatus and appliances during the first quarter of this year at £45,380,000, the *Board of Trade Journal* gives the value index as 125 (1950 = 100) against 126 for 1953. On the other hand the volume index shows a rise from 99 in 1953 to 106 in the first quarter of this year.

INDUSTRIAL NEWS

German Technical Training

A STUDY OF technical training methods in North-West Germany was recently made by Dr. K. R. Sturley, head of the B.B.C. Engineering Training Department, at the invitation of the Foreign Office. In the course of this Dr. Sturley visited schools and industrial and other establishments in Hamburg, Hanover and Berlin. A report on the tour outlines the German educational system generally, and industrial training and apprenticeship methods.

Dr. Sturley finds that craft apprenticeship is well organized; there is no evidence that the standard of craftsmanship is higher than in England but a far larger number of school-leavers are receiving vocational training of a high standard.

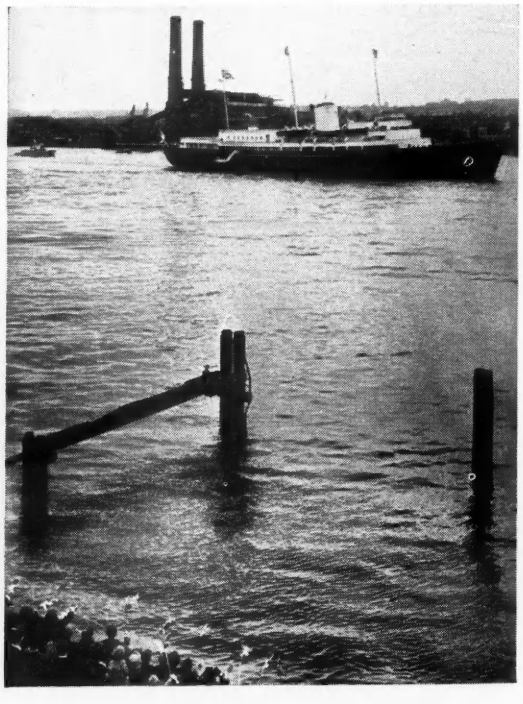
It is considered that we are more advanced than the Germans in the training of engineers who have worked their way up through industry. Moreover, the two-year graduate training schemes of many large British firms appear to be in advance of the German method of requiring only six months' pre-graduate and six months' vocational training. In Germany there is nothing comparable with the scholarship facilities available to the first-class English school-leaver of university education and little opportunity of obtaining courses at post-graduate level.

Dr. Sturley found that technical efficiency appeared to be more highly rated than education and citizenship. He thinks that encouragement and, if possible, assistance could well be given to German industrial training officers to visit this country.

Conditions of Contract

A new model form of general Conditions of Contract known as "B3 — Export Contracts (including Delivery to and Erection on Site of Electrical and Mechanical Plant)," has been prepared by the Joint Committee on Model Forms of General Conditions of Contract of the Institution of Mechanical Engineers and the Institution of Electrical Engineers, and published (price 5s) under the authority of the Councils of the two Institutions. The new Form supersedes the provisions of the existing Form "B2" which dealt with this type of contract for electrical work. Form "B2," however, continues to be available for use in electrical export contracts involving supervision of erection only. The new Model Form is obtainable either from the secretary of the Institution of Mechanical Engineers, 1, Birdcage Walk, London, S.W.1, or from the secretary of the Institution of Electrical Engineers, Savoy Place, London, W.C.2. Consideration is being given by the Joint Committee to the preparation of additional model forms of contract for Export.

The "Britannia" passing Henley's Cable Works at North Woolwich on Saturday last on her way to the Tower Bridge. In the background is Woolwich power station



Works Visit

On 11th May a party of fifteen representatives of American journals and news services visited Ferranti, Ltd., Hollinwood, and made a tour of the Transformer, Meter, and Insulation Departments. They came as guests of the Dollar Exports Council and travelled by air direct to Ringway, Manchester. This was actually the first return flight of the new B.O.A.C. Manchester–New York Air Service. After the tour, the guests were entertained to lunch at the Midland Hotel, Manchester, by Mr. Sebastian de Ferranti, Mr. Basil de Ferranti and several executives of the Ferranti company.

Telecommunication Equipment for Canada

Through its associate member of the English Electric group, Marconi's Wireless Telegraph Co., Ltd., has received a large order to provide the Canadian Overseas Telecommunications Corporation with specialized equipment for new long-distance radio transmitting and receiving stations. This equipment, to a value of the order of several hundred thousand dollars, includes high power single side band Marconi type "HS 51" transmitters, each, with a peak envelope power of 30 kW, capable of transmitting four telephone channels at once while offering facilities either for multi-channel or normal frequency-shift telegraphy; single side band and double diversity telegraph receivers of the latest Marconi "HR 93" and "HR 12" types; and telephone terminal and privacy equipment manufactured jointly by Marconi's and Siemens Brothers & Co., Ltd. Orders have been received at the same time for additional equipment for the existing transmitting and receiving stations at Drummondville and Yamachiche.

Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM Ingots	ton £156 0s 0d
COPPER, H.C. Electro	ton £242 0s 0d
Fire Refined 99·70%	ton £241 0s 0d
Fire Refined 99·50%	ton £240 0s 0d
COPPER Tubes ..	lb 2s 4½d
Sheet	ton £303 15s 0d
H.C. wire and strip ..	ton £273 15s 0d
LEAD, English ..	ton £94 10s 0d
Foreign	ton £93 0s 0d
MERCURY	flask £85 0s 0d
TIN, block (English) ..	ton £723 0s 0d
ZINC, G.O.B. Foreign	ton £86 0s 0d
Electrolytic	ton £87 0s 0d
BRASS Tubes (solid drawn)	lb 1s 11½d
Sheet	ton £249 0s 0d
Wire	lb 2s 6½d
PHOSPHOR BRONZE Wire	lb 3s 10½d
PLATINUM	oz £30 0s 0d
RUBBER, No. 1 R.S.S. spot	lb 18½d–19d

American Electrical Films

From the U.S. Operations Mission to the United Kingdom, American Embassy, 5, Grosvenor Square, London, W.1, we have received a catalogue of industrial films. In this a number of electrical films are included,

Visitors to the Northern Works and Laboratories of British Insulated Callender's Cables, Ltd., and the Automatic Telephone and Electric Co., Ltd.

supplementing the list given in our issue of 9th April. Among them are "Commutation of D.C. Machines," "Direct Current Controllers," "Hints on Electrical Servicing," "Preparing Old Buildings for Wiring," "Roughing-in Non-Metallic Sheathed Cable," "Selecting the Right Industrial Distribution System," "Three-wire Service," "Wound Rotor Controllers" and "Radio-frequency Induction Heating." There are also films on many allied subjects such as mechanical handling, refrigeration, welding, heat treatment and machine shop practice.

Railway Equipment Exhibition

The biggest and most varied exhibition of railway equipment held in this country since the war is to be staged by British Railways and London Transport at Willesden Motive Power Depot, Goodall Street, London, N.W.10, from 25th to 29th May. On view will be over 100 large exhibits including locomotives, carriages, wagons, signalling apparatus and permanent way equipment, as well as ship models and various tools and appliances. Delegates to the Congress will visit the exhibition on 25th May and it will be open to the general public on the following days.

Teaching Staffs' Works Visit

Close liaison with universities and technical colleges is one way of ensuring a steady influx of new and trained personnel into an industry. Last week a large party of professors, lecturers and appointments officers was invited to an extensive three-day tour of principal factories of British Insulated Callender's Cables, Ltd., at Leigh, Prescot and Helsby, and the main works of the Automatic Telephone & Electric Co., Ltd., in Liverpool.

On Tuesday, 4th May, guests were welcomed at the B.I.C.C. Prescot works by Dr. L. G. Brazier, director of research, and during the afternoon they visited the Helsby works. After dinner at the Adelphi Hotel, Liverpool, Mr. W. H. McFadzean, deputy chairman and chief executive of the company, spoke of the need for suitable men for responsible positions in the electrical transmission field. On behalf of the visitors Prof. B. Hague, James Watt Professor of Electrical Engineering and Dean of the Faculty of Engineering at Glasgow University, thanked the company for its hospitality and said all were impressed by what had been seen and arranged.

The next day the visitors were welcomed to the Strowger works of A.T.E. by Mr. F. C. Burstall, deputy managing director, and were shown the great scope of the telecommunications field, especially in electronics. During the afternoon the party toured the B.I.C.C. Anchor works at Leigh, and were entertained to dinner at the Royal Hotel, Southport. The visit concluded on Thursday with a tour of B.I.C.C. Kirkby laboratories where the party saw a variety of research and development methods.

Simms Instruction School

The new instruction school of Simms Motor Units, Ltd., is now functioning at the head office of the company at Oak Lane, East Finchley, N.2. The school is a self-contained unit and is designed to provide practical and theoretical instruction on all features of the fuel injection and electrical equipment manufactured by the company. A wide range of new test plant has been installed in the school building, which in its layout, lighting and decoration provides an atmosphere free from distraction and conducive to the study of operational and service problems.

The student capacity of the school has been limited deliberately to ensure the maximum of personal attention for those who attend—a practical course consisting of approximately four students and a theory course of up to twelve students. The courses, which are normally of one week's duration, are open to foremen and mechanics from branches and overseas agents, foremen and mechanics from service depots, and service engineers and students on the staff of vehicle manufacturers or operators.

Mechanical Handling Exhibition

The June issue (published 3rd June) of *Mechanical Handling* will be a greatly enlarged, special number containing a preview of the Fourth Mechanical Handling Exhibition and Convention which that journal is organizing at Olympia from 9th to 19th June. The contents will include a directory of exhibitors, floor plans, a fully-illustrated description of exhibits, and the full Convention and film programme. Copies (price 2s 6d) can be obtained through newsagents or direct from Dorset House, Stamford Street, London, S.E.1.

Gauge and Tool Export Catalogue

The Gauge and Tool Makers' Association has issued the third edition of its

The new instruction school of Simms Motor Units, Ltd.

Export Catalogue in English, French and Spanish. It contains particulars of the aims, objects and export activities of the Association and there are over 150 pages illustrating and describing the products of member manufacturers. Copies will be sent overseas free of charge, but British concerns and agencies requiring a copy are asked to send a P.O. for 6d to cover the cost of postage. Application should be made to the Association at Standbrook House, 2–5, Old Bond Street, London, W.1.

Telephone Cables for Alberta

Enfield Cables, Ltd., announces that it has received during the past few months an interesting series of orders for telephone cables from the City of Edmonton, Alberta, Canada. These orders, all of which are being manufactured to Canadian Specification, call for more than 80,000ft of dry-core cable of the twin and twin unit types, of an overall value of 72,997 Canadian dollars. The orders were obtained in the face of international competition. The cables are being manufactured by Southern United Telephone Cables, Ltd., at Dagenham, in which company Enfield is one of the shareholder members.

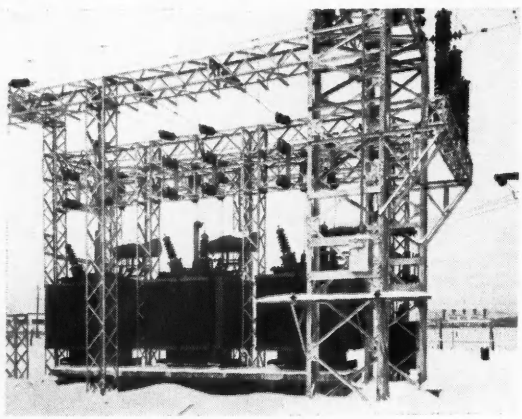
New Cable Ship Launched

The c.s. *Recorder* (3,300 tons), the British Commonwealth's most modern cable repair ship, was launched at Newcastle-upon-Tyne on 3rd May. She is being built for Cable & Wireless, Ltd., at the Neptune Shipyard of Swan, Hunter & Wigham Richardson, Ltd. Major-General L. B. Nicholls, chairman of Cable & Wireless, Ltd., said at the launch tea that, despite the great development of radio, the future of the submarine cable was secure and the demand for cable ship construction would grow in future years. The new ship was named by his wife, Mrs. Nicholls.

Transformers for Canada

In the accompanying picture we show a group of three Denis Ferranti 66 kV, 60 c/s, single-phase transformers forming a 10 MVA 3-phase bank, which have recently been installed at Valcartier, Quebec. They were supplied through the company's sole agents, the Eastern Electrical Supply Co., of Montreal.

Denis Ferranti 66 kV transformers installed at Valcartier, Quebec



Crane Company's Conference

A conference of nearly 100 overseas distributors and sales agents will be held by Steels Engineering Products, Ltd., manufacturers of Coles mobile cranes, electric trucks and hoists, at Harrogate from 29th May to 6th June. During the conference a visit will be paid to the company's works at Sunderland.

Air Freight to Tokio

The General Electric Co., Ltd., has recently arranged, through its forwarding agents, Lambert Brothers, Ltd., the shipment by air to the Far East of nearly five tons of turbine parts required urgently at Hiroshima for essential replacements in the T.E.V. *Empire Wallace*, a heavy lift cargo vessel.

Because of the weights involved and the formidable cost of chartering a plane for the whole distance, the turbine parts were broken down into four lots and the first load, of 5,947 lb, was shipped from Croydon airport by Transair Dakota to Geneva, where it was transhipped to a York aircraft for Bangkok. There was a further transshipment at Bangkok to a Skymaster for Tokio. The remaining turbine parts were dispatched by Pan-American passenger-freight service to Tokio from London Airport in three separate lots.

Aluminium Development Association

The retiring president, Mr. R. D. Hamer, presided at the annual general meeting of the Aluminium Development Association held at 33, Grosvenor Street, London, W.1, on 23rd April, and introduced the report for 1953. In recording the principal activities of committees and staff over many and varied subjects, the report showed good progress with the three-year programme of research and development work begun in 1952 with particular emphasis on the structural, marine and electrical engineering fields. During the year part of the Association's research activities culminated in the publication of nine new research reports. There was also a continuation in the trend of educational services with a considerable increase in the use made of them by educational authorities and individual teachers. The demand upon the Association's technical services had increased in practically every direction—for example, over 150,000 copies of new or revised publications were dispatched (compared with 130,000 in 1952) and over 430 film shows were given; present library resources include 1,300 literary acquisitions, over 6,300 photographs and more than 2,000 lantern slides.

Nechells "B" Generating Station

We learn that the forced draught and induced draught fans and stoker motors at Nechells "B" generating station which was described in our issue dated 14th May were supplied by Laurence, Scott & Electromotors, Ltd. These machines were all of the a.c. variable speed type with induction regulator control.

Food Traders' Exhibition

An exhibition is being staged by Prestcold Refrigeration at Turnham Green Church Hall, Chiswick, London, W.4, from 19th to 28th May. Some thirty Prestcold refrigerated exhibits of special interest to food traders are on show.

Silicone Travelling Exhibition

Midland Silicones, Ltd., is beginning its travelling exhibition with a show at the Nottingham and District Technical College from 22nd to 26th June inclusive. The exhibition will show some of the many uses to which these materials are being put. The whole range of silicones will be covered.

Catalogues and Lists

Electric Transmission, Ltd., Etruria, Stoke-on-Trent, Staffs.—Illustrated technical catalogue of "Eetee" fuse-links for operation under oil (ETFS20).

Dubilier Condenser Co. (1925), Ltd., Ducon Works, Victoria Road, North Acton, London, W.3.—Catalogue concerning Dubilier capacitors (GC.354) together with leaflet on radio and television interference suppression (ST/R.254).

A. Reyrolle & Co., Ltd., Hebburn, Co. Durham.—Installation and maintenance recommendations for oil-filled post-type current transformers—88 kV to 275 kV (IOMS417) and revised edition of the Relay Handbook (1224).

J. H. Tucker & Co., Ltd., King's Road, Tyseley, Birmingham, 11.—Illustrated leaflet introducing Tucker "Five-Eight" plaster depth 5 A a.c. flush switches, and a leaflet on large flanged locking ring assemblies.

Air Control Installations, Ltd., Ruislip, Middx.—Publication describing the "Windovent" window fan (FA.534) and a leaflet containing particulars of the "Dusgard" unit for control of dust from pedestal grinders (E.535).

Electro Dynamic Construction Co., Ltd., St. Mary Cray, Kent.—Two illustrated catalogues of high frequency inductor motor alternators (16.HF) and fully automatic stand-by diesel alternator sets (19.SS).

Simplex Electric Co., Ltd., Broadwell, Oldbury, Birmingham.—"Hot Water by Creda"—a new water heating equipment leaflet (WH.20).

Geo. W. King, Ltd., Stevenage, Herts.—Illustrated leaflet on overhead runways.

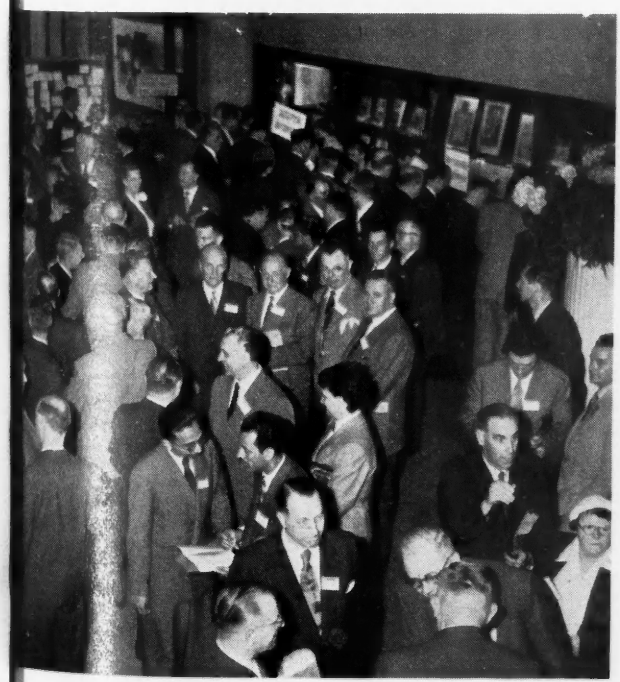
C.I.G.R.E.

International Conference on Large Electric Systems

Dr. R. A. Schmidt (president) speaking at the opening ceremony. With him are Sir Vincent de Ferranti, Mr. A. Rusck (Sweden), Mr. A. Louvel (French Minister of Industry and Commerce) and Mr. J. Tribot-Laspière (delegate-general)

THE fifteenth biennial International Conference on Large Electric Systems (C.I.G.R.E.) opened in Paris on 12th May and concludes to-morrow (Saturday). It is being attended by about 240 British delegates, and 33 of them submitted 19 papers or special committee reports. There was a variation of the usual procedure in that the official inauguration took place on Wednesday afternoon, 12th May, to permit delegates to attend a meeting in the morning in celebration of the diamond jubilee of the Ecole Supérieure d'Electricité which was held in conjunction with the Société Française des Electriciens. On the latter occasion Mr. Gaspard (director-general, Electricité de France) presided and Mr. P. Ailleret delivered a lecture on " The Evolution of Electric Power Transmission Technique." This formed an appropriate introduction to the opening ceremony of C.I.G.R.E., over which Mr. Louvel, Minister of Industry and Commerce, presided.

Group at the Conference Hall before the opening ceremony. In the centre can be seen Messrs. H. Nimmo, V. A. Pask, D. Kingsbury R. L. Batley and J. F. Elphick



Dr. R. A. Schmidt (president, C.I.G.R.E.) referred to Mr. Louvel's earlier connection with the electrical industry, which made him " one of us " and to the presence of Col. E. Mercier (former C.I.G.R.E. president) and of Mr. J. Tribot-Laspière, who had organized these conferences since the beginning in 1921. Membership had nearly doubled since the war and now numbered over 1,500 from 45 different countries. Transmission problems were the same in all parts of the world and so needed to be discussed internationally.

Mr. A. Rusck (president, Swedish Power Board), on behalf of the English-speaking delegates, also emphasized the value of exchange of experience and new ideas across all frontiers. A large part of the success of the Conference he attributed to the limitation of its activities to the special purpose for which it was founded, which avoided overlapping with other organizations. Mr. C. E. Montanès (Spain), for the French-speaking delegates from other countries, added to the thanks to our French hosts for the excellence of the arrangements made.

Mr. Louvel said that he had kept in touch with recent developments in the electrical industry in all countries, mentioning particularly the crossing of the Straits of Messina by overhead line by Italian engineers, the 380 kV and 100 kV d.c. submarine schemes in Sweden and the proposal for a Channel crossing to link the grids of Britain and France. He referred to the coming of a new stage in electrical development through atomic energy and rejected any suggestion that it would mean the suicide of civilization.

Technical discussions of over 132 papers and special reports submitted by authors from many countries started on the following morning, two groups being dealt with simultaneously—an arrangement continued throughout the conference. Those in Room A concerned alternators and those in Room B insulating material in the morning and substations after lunch. Among the points put forward by Belfils (France) and Wust (Belgium) were that the ceiling exciter voltage should be 1·5 times full load excitation with a per unit response of 2 to 3 when stability of long distance transmission was a limiting factor. Measurements of winding temperatures

as shown by thermocouples and by resistance had differed by from 15 to 30 deg C. Damage to stator insulation due to creep could be prevented, Abegg (Switzerland) claimed, by the use of synthetic thermosetting resin with a base of ethylene oxide. Way (Canada) emphasized the predominant importance of maximum operating temperature in insulation deterioration.

Vidmar (Jugoslavia) submitted that of the four usual types of exciter, a shunt machine with a pilot booster gave the highest rate of response. Very rapid control of excitation in hydro stations was shown by David and Gatesoupe (France) to be obtained by spontaneous impulses in association with normal regulators or by amplidynes with electronic regulators, which were comparable with magnetic amplifiers. In hydro-electric stations subject to considerable variations in head of water, Tittel (Germany) showed that alternators should function at two speeds by pole changing to secure highest turbine efficiency. Similar conditions obtained for pumped storage schemes, in which a higher speed was required for pump operation.

Of the seven papers on insulating materials, five dealt with oils and two with synthetic resins. Booth and Johnson (Henley's) showed that the addition of small quantities of materials to increase viscosity of base oils of cable compounds produced comparatively large changes in the impulse breakdown strength, as determined by a new test cell. Refined wood rosin markedly improved impulse strength, compared with polyisobutylene, the other common additive. Other organic substances were also found to alter breakdown strength, increases of over 40 per cent having been obtained with oils for transformers and oil-filled cables.

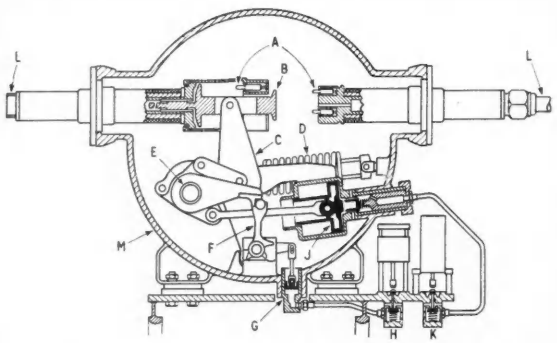
Interfacial tension and neutralization were regarded as satisfactory criteria for quickly evaluating used oil by the Hydro-Electric Power Commission of Ontario, it was stated by Chisholm. Absorption purification was held by Larsson and Hyyrylainen (Finland) to be sufficient and economical for oils with a low neutralization number.

Under the heading of substations came a paper by Szwander (Belfast Corporation), who urged the need to use schematic diagrams, as distinct from wiring diagrams, in the design and operation of switchgear installations and analysed the conditions to be satisfied by them. The "detached contacts" type of diagram was recommended and methods of constructing and using examples were illustrated, especially in relation to circuit standardization. International standardization of methods of construction was advocated.

Features of a contribution by Brambilla (Italy), describing the layout of an underground 220 kV transformer substation in a residential area of Turin, were the means adopted to economize space and to avoid local disturbances.

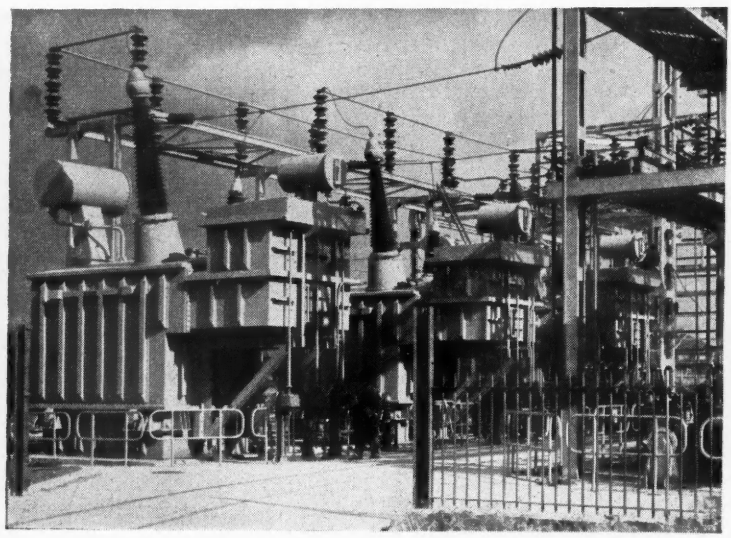
On Friday the alternatives offered were circuit breakers and insulators, succeeded by teletransmission. Of outstanding importance in Room A was the information given by Christie and Leyburn on the new Reyrolle research station for high power circuit breakers (see *Electrical Review*, 2nd April). This station was built for carrying out full-scale single-phase or unit tests on almost any circuit breakers at three-phase voltages up to 380 kV that would be needed in the foreseeable future and to speed up the increasing demands for proving tests and research under widely varying service conditions. The outputs were believed to be the highest available in any testing station.

Results of a survey of inherent restriking voltage characteristics representative of all circuit breakers on the British 132 kV grid system were given by Gosland and Vosper (E.R.A.). Limiting curves were indicated for 1,500, 2,500 and 3,500 MVA. An estimate was made of limiting conditions for 7,500 MVA 275 kV substations, at which rates of rise of restriking voltage, calculated for the most onerous conditions, would sometimes be approached in practice, assuming the non-occurrence of three-phase faults not to earth or else that substantial lengths of insulated conductor would always remain connected beyond faults. Field tests on 380 kV circuit breakers carried out in Sweden were reported by Jancke and Sandstrom to have indicated a maximum over-voltage factor when opening an unloaded transmission line of 2·4 for minimum-oil circuit breakers, the figure being 1·3 for the air-blast type, which reached 2·3 for the interruption of a reactor-loaded transformer, compared with 2·4 for the minimum-oil type. Over-voltage was higher with air-blast (1·7) than with minimum-



Interior of making switch. A, fixed contacts; B, moving contact; C, contact lever; D, operating spring; E, main shaft; F, tripping latch; G, tripping-relay cylinder; H, trip valve and magnet; J, piston for charging operating spring; K, charging valve and magnet; L, terminals; M, pressure tank

Below: E.h.v. transformer bank at the Hebburn-on-Tyne research station of A. Reyrolle & Co., Ltd.



Group at the Lutetia Hotel: Mrs. Green, Mr. and Mrs. D. P. Sayers, Mr. G. N. Green, Mr. and Mrs. J. S. Pickles, Mr. W. N. C. Clinch, Mrs. Sawtell, Mrs. Clinch and Mr. and Mrs. J. Henderson

oil (1·5) for an unloaded transformer. Switching over-voltages would probably be less at 380 kV than at lower voltages; conditions were, however, favourable owing to the inclusion of about 70 miles of 380 kV cable in the testing network. Such over-voltages could best be reduced, according to Bergstrom, Johansen and Grundmark (Sweden), by non-linear resistors in parallel with the break.

Pantograph and jointed-arm (mono-insulated) isolators were claimed by Verde and Pedante (Italy) to possess advantages in cost and maintenance (increasing with voltage) over rotary isolators at from 120 to 220 kV.

Oscillograms of over-voltages due to disconnection of unloaded transformers were stated by Poma and Richard (Belgium) to reveal that these were less severe with slow than with quick circuit breakers, though more liable to restriking and oscillations, and that they could be suppressed by connecting capacitors across the transformer terminals. These views were in close agreement with those expressed by Roth and Strickler (Switzerland). After referring to the principle that the essential criterion of circuit breaker efficiency was the recovery of dielectric strength in the space between contacts after arc extinction, Hochrainer (Germany) submitted a formula for the relation of breaking capacity with network frequency and amplitude factor. Measurements near current-zero passage of a.c. arcs up to 4,500 A (peak) were reported by Horst and Rutgers (Netherlands), who found the average peak value of current during pauses (ranging from 10 to 100 microseconds) to be 1 per cent. Tests at Fontenay by Cabanes, Dietsch and Divan had indicated that for 220 kV lines of about 400 miles complete de-ionization of a single-phase arc path was obtainable but might take longer than the usually acceptable limit of 0·25 to 0·30 sec. This would then preclude the use of ultra-rapid single-phase automatic reclosure.

At the parallel meeting a report of an international study committee on overhead line insulators was presented by Gillam (Taylor, Tunnicliff). It was recommended that live line tests, involving comparison of potential drops across individual cap-and-pin units of suspension and tension strings, should be made when atmospheric humidity was under 70 per cent to avoid effects of surface pollution on voltage distribution. Difficulty in using testing sticks at 380 kV, owing to the length and weight, was reported by Zetterholm (Sweden). Live line testing was said not to be permitted in France.

Portable apparatus for applying tests at more than

Another Lutetia Hotel group: Messrs. G. B. Harper, A. Chorlton, L. Couros, J. A. Nott, E. C. Scott, R. R. B. Brown, E. J. Whitcher, H. B. Laine, M. Kaufmann, F. T. Simpson and C. W. Marshall

100 kV to insulators on dead lines was described by Mayer (Germany); it consisted of an accumulator feeding short current impulses to a transformer and was said to be in use in Germany, Austria and France.

Laboratory rain tests were regarded as of little value in assessing insulator performance, the preference being for the simulation of working conditions in polluted atmospheres and in mist or fog. No satisfactory pollution test of short duration suitable for a specification had yet been evolved. Flashover under rain was said, by Estorff and Lapple (Germany), to be determined by water drops hanging from the edges of sheds and not by a water film on the surface, the rain test being no criterion for the development of more economical insulator shapes; control rings, they considered, were required only at 330 kV and above. Laboratory tests, Sheadel (U.S.A.) stated, had indicated no upper voltage limit for standard cap-and-pin suspension insulators.

On Friday evening was held the first of the series of social interludes, so kindly arranged by our French hosts, which provided an effective safeguard against the staleness which might otherwise result from assiduity in technological matters. The dance indoors and out of doors at the Cercle Interallié was as enjoyable an affair as in previous years.

Transformers provided Saturday's task in Room A, when an international report on impulse testing, thermal rating and ionization was submitted by Norris (Ferranti). Stenkvist (Sweden) referred to the unreliability of fault indication by impulse testing when voltage oscillograms were unaccompanied by records of the current.

Delegates collecting papers, badges, etc., in the Conference Hall

Mr. C. C. Barnes, Mr. G. N. Green and Mr. W. N. C. Clinch

Two ways of conducting impulse tests on the neutral point of star-connected transformers were considered—first when the neutral was directly earthed through the measuring shunt and, secondly, when the neutral end was not available, in which case the live terminals of the two phases not under test were connected in parallel and directly earthed through the measuring shunt. Norris observed that the first method was closer to service conditions. Opinions differed in regard to tests on transformers on non-effectively earthed systems and also on the position of a tap-changer during an impulse test. Deviations of full-wave oscillograms from calibrating oscillograms due to irregularities outside the winding had been overcome by using a double shielded measuring cable between the shunt and the oscillograph.

Tests with chopped waves should preferably not be used as commercial tests until reproducible oscillograms could be obtained. The American method of indicating smaller faults on tests with chopped waves by oscillograms from following full-wave tests did not meet with general approval.

Thermal rating was dealt with by Chevalier (Belgium) under the headings of effective mean oil-temperature rise, hottest-spot temperature and ageing. The present rules relating 95 deg C hottest spot with a 20-year life gave too large a factor of safety; the limit was reached when a transformer failed to withstand the standard dielectric and short-circuit tests. Langlois-Berthelot (France), who also contributed a special report on transformers, referred to the threshold voltage of ionization as being of definite physical significance. Measurements of dielectric fatigue for insulations in air were far less difficult than for those in oil, the quality of which could materially affect the threshold of ionization.

On-load tap-changing was surveyed by Rippon (Parsons), who pointed out that while the arrangement of one selector switch for each tapping resulted in a relatively simple selector switch mechanism, its use was limited to 11 to 15 tappings and to consideration of impulse voltage distribution. Coarse and fine tappings were generally used for numbers in excess of 15, since only about half the selector switch contacts were required; the drive for the change-over switch, however, complicated the mechanism. In a third arrangement, now usually restricted to series or shunt voltage booster transformers, the switch gave $\pm$ operation, the tapping winding being connected in the main winding for boosting or bucking; the copper loss was high at minimum voltage and the difference in resistance on maximum and minimum tappings might be very large, whereas the range, it was generally agreed, should normally not exceed 30 per cent. Percentage limits for tapping steps were suggested of 2·5 of the nominal voltage for transmission and 1·5 for distribution.

At a parallel meeting for the discussion of interference with telephone and radio, Marshall (B.E.A.), chairman of the relevant study committee, stated that in Great Britain during 1951–53 there had been no injuries or damage due to accidental contact between power and communication circuits. Inductive effects due to earth faults by two aircraft collisions, which interfered with the Post Office system, showed the need for the development of surge protective devices for lightly insulated lines. Two earth faults on a 33 kV line had interfered with railway signals, which, together with Post Office lines, had suffered inductively from open-circuiting of power lines.

Local action sufficed to remedy the few cases of interference with radio and television for which faulty line joints and mercury arc rectifiers were mainly responsible. Perspective was given by figures relating to the magnitude of the British electricity supply system which comprised

7,000 circuit miles of overhead lines at 66 kV and over and 86,000 miles (including cables) at lower voltages down to 650 V.

Rectifier harmonics provided the subject of a contribution by Friedlander and Thompson (G.E.C.), who had worked out a new equivalent circuit which took into account the two harmonics (e.g., the 5th and 7th for a six-phase rectifier) which were interlinked through the d.c. output. This circuit agreed with the conventional picture only in the limiting case of the complete smoothing of the d.c., e.g. by a large cathode reactor. It was found that the a.c. voltage harmonics penetrated to the d.c. side with equal percentage amplitude, whereas the predominant d.c. ripples were transferred to the a.c. side and were shared by associated pairs of a.c. harmonics in each of the three phases. Methods of discrimination between harmonics of different origins and of referring all harmonics back to the fundamental frequency network impedances were also shown.

On insulation co-ordination, Herlitz and Jancke stated that the tendency everywhere was to adopt direct earthing at voltages above 220 kV and as line lengths grew to change over from Petersen-coil earthing.

On Saturday evening there was a drive through Paris where the principal buildings have been floodlit.

(To be continued next week.)

Large Private Telephone Exchange

1,200-LINE SIEMENS INSTALLATION FOR SHELL PETROLEUM

OWING to the rapid post-war expansion of the Shell Petroleum Co., Ltd., at St. Helen's Court, London, it became necessary to replace the existing internal telephone exchange by one with considerably more lines, able to be extended to any size without major modifications. Siemens Brothers & Co., Ltd., were consulted and on 15th May the new Siemens No. 17 P.A.X. equipment was put into service.

Equipped initially for 1,200 lines and over 70 junction circuits to other exchanges in the Shell Organization network, the No. 17 P.A.X. is the first of its type to be used anywhere in the world, and can claim the distinction of being Britain's largest privately owned telephone system.

The design was started before the war under the leadership of Mr. H. E. Humphries, now managing director of Siemens Brothers & Co., Ltd., and an entirely new approach to the question of switches and switching arrangements was one of the first tasks of the team. Two new types of switches, the motor uniselector and the digit switch, were the ultimate result. Both of these switches are used exclusively in the No. 17 automatic equipment.

The No. 17 P.A.X. is the only large switch system which does not require the use of wiper cords to make connections to the moving parts of the switches and for the first time double contacts are employed at all light current switch points giving stability of adjustment with freedom from faults and a length of life not previously obtainable.

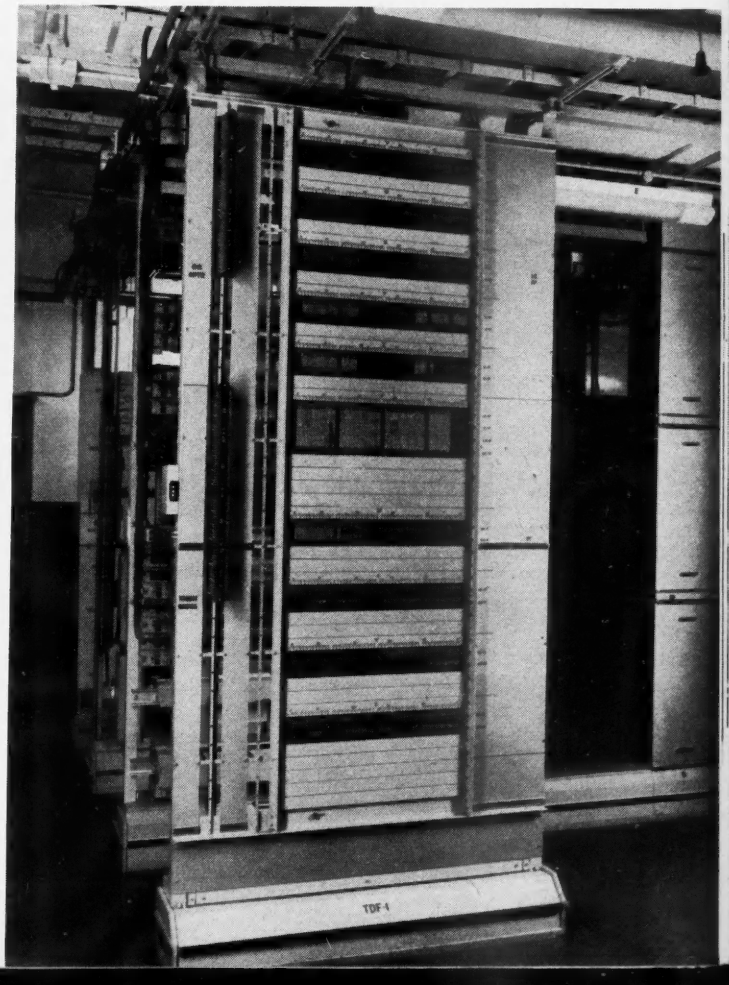
The main functions of the new exchange are to provide fully automatic working between telephone instruments at the Shell headquarters, involving at present 1,200 lines, in addition to which the exchange acts as a coupling exchange for all telephone calls between any two buildings throughout the whole Shell network. This includes Shell Court with 700 lines, the Kingsway, City Gate House, Finsbury Circus, and Ibex House offices with 200 lines each, and the St Swithun's office with 190 lines. Prefix digits are used to route calls so that they may be localized into head office calls, and head office to or from any of the satellites, or from one satellite to another via the head office equipment.

The equipment has a number of maintenance features, one of which is the " call-trace " whereby, under certain conditions, a call may be traced back automatically.

Some 504 motor driven uniselector switches are used in the system, and the speed of the uniselector is such that it will search for free outlets at the rate of 200 per second. At this speed, the stopping of the switch at the desired outlet entails auxiliary apparatus capable of operating almost instantaneously, and a Siemens high-speed relay which operates in 0·001 sec fulfils this condition.

The units of the equipment are mounted on racks 8ft 6in high and 4ft 3in wide, and all working apparatus is totally enclosed with easily detachable covers. Finished in mottled grey, the whole system is housed in spacious accommodation. Fluorescent lighting equipment, designed and made by Siemens Electric Lamps & Supplies, Ltd., ensures efficient illumination in all positions, thus facilitating maintenance.

Some of the equipment in the new Siemens No. 17 P.A.X. at the headquarters of the Shell Petroleum Co., Ltd.



FUTURE FUEL SUPPLIES

PRODUCTION AND CONSUMPTION TRENDS

AN outline of Britain's coal prospects for the next 50 years was given in a lecture "Fuel Supplies of the Future" to the Utilization Section of the Institution of Electrical Engineers on 13th May by Mr. D. Hicks, director of scientific control of the National Coal Board.

Mr. Hicks said Britain's prosperity had largely been built on cheap coal. To-day, we neither produced enough coal to meet our needs, nor did we produce it cheaply. Our economy was artificial, depending on a large turnover of imports and exports, and this could not be achieved without a sufficiency of low-cost energy.

The production of primary fuels in the world was steadily increasing. In 1938 the production of coal and lignite was 1,300 million tons. To-day it was over 1,500 million tons. The production of oils in 1938 was 228 million tons; it was now nearly 600 million tons. The production of natural gas had trebled and the production of electricity from water power had increased between three and four times. In this country, however, the production of primary fuels was less than before the war, but it was important to remember the relative importance of different primary fuels. Converting all fuels to a common basis—coal equivalent or kWh—it was found that solid fuels represented only 30 per cent of world primary fuel output. The remainder was made up of petroleum, wood, peat and natural gas. In the United States coal and lignite were no more than 40 per cent of the total primary fuels; petroleum accounted for over 30 per cent and natural gas for 25 per cent. The great flexibility of American primary fuel supplies was markedly different from the position in this country, where 88 per cent of the primary fuel used was coal. We were a one-fuel country, for, although we used large quantities of oil, we had to import them.

The general level of the consumption of energy depended on three things—population, climate and standard of living. In Britain, the standard of living was directly proportional to the national income. The world population was about 2,400 million, and primary fuel production was at the rate of one ton of coal equivalent per head. The population was increasing by 1·25 per cent per annum, and it was likely that the production of primary fuels could keep pace with this, but the variation from country to country was enormous. In America, at coal equivalents, the consumption of fuel was six to seven tons per head of the population; in Russia it was about 1·2 tons; in Europe, 2·2 to 2·3 tons; in Britain 4·8 to 5 tons. Our consumption was the largest in Europe, but if we were to achieve the same level of productivity as America, our consumption per head must increase. We ought to be thinking in terms of an annual fuel consumption of 300 million tons of coal equivalent, but the present figure was about 250 million tons.

Mr. Hicks mentioned the great increase in the consumption of oil in this country since 1938 and added that the inland consumption of coal itself was about the same as in 1938. A major change in the pattern of energy consumption since before the war was the increased use of gas—about double—and of electricity—from 20,000 million kWh to 53,000 million kWh. The increased production since the war must be related to this increased use of energy, but other countries were also increasing their consumption of electricity. In this country, the consumption of electricity per head was a little over 1,000 kWh per annum, whereas the American figure was 2,000–3,000 kWh—and this disparity accounted for the difference in productivity. Britain's domestic market consumed about 55 million tons of solid fuel before the war and consumed 42 million tons now; it now consumed about 1,400 million therms of gas, compared with 900 million before the war; it consumed 17,000 or 18,000 million kWh of electricity, compared with 5,000 to 6,000 million before the war. This represented a consumption of 70 million tons of coal equivalent—about one-third of our coal production. It equalled 1½ tons of coal per head of the population per annum. In France the figure was only half a ton, although the average day temperature was only 4 deg F higher. In Belgium the figure was about three-quarters of a ton.

Turning to fuel consumption by the railways, Mr. Hicks said this had remained constant at between 13 million and 15 million tons since 1909. Although it was important to seek economies, it must be remembered that the steam locomotive was a very cheap instrument and the cost of fuel per useful unit of work was low. "What should the future policy of the railways be? It should be determined entirely on the economics of the situation and not solely in terms of economy in tonnages of primary fuels. . . . The railways have a simple test: can traffic receipts be increased by changing from one method of locomotion to another? Past experience suggests that whenever the electrification of suburban traffic has been undertaken, there is always a substantial increase in receipts, which pays for the investment, and I think British Railways will probably consider the wholesale electrification of suburban traffic. Over the next 10 or 15 years we can look forward to further, but not wholesale, electrification of the railways."

Electricity and Productivity

Speaking of industrial fuel consumption, Mr. Hicks pointed out that industry was widely dispersed and its consumption was at a low rate. It was unlikely that any great improvement in fuel efficiency would be achieved by exhortations or public relations. "It can only be achieved," he said, "by investment in new plant and investment in well-trained engineers who will devote their attention to the problem. We can maintain our position as an industrial nation only if we consume more energy, and in the main that increase will have to be in the form of electricity. As a nation we can confidently look forward to a steady growth in the use of power in the form of electricity and the plans of the British Electricity Authority, which postulate a consumption of 65 million tons of coal in 1965, are well based. There is nothing unique about this steady increase in the use of electricity; it is taking place in every country, and if we fall behind our competitive position will become worse."

Mr. Hicks dealt next with future supplies of coal to meet these increased demands. He said our reserves of high grade coal were being depleted and in the next 10 or 20 years it would become increasingly difficult to meet the demand for high-grade coal. Our reserves of good coking coal were falling, and we could predict their life; it might be 100 years, in some cases 50 years. The country would have to use less good coking coal and to adjust its practices accordingly. The quality of our seams would definitely decline over the next 50 years, and those generating electricity would have greater difficulties from higher ash, higher sulphur and higher chlorine, as well as other elements which became increasingly important as boiler temperatures and pressures rose.

GENERATION AND DEVELOPMENT

Generation in April

IN APRIL the increase in electricity generated by the British Electricity Authority and the North of Scotland Hydro-Electric Board (6·9 per cent) was lower than in the preceding three months of the year and the average rate fell from 10·8 to 9·9 per cent. The total installed capacity of generating plant at the end of April of 19,208 MW represented a net reduction of 24 MW compared with March.

ELECTRICITY GENERATED AND PLANT INSTALLED*

	Fuel consumed Thousand tons			kWh generated Millions			kWh sent out Millions	Installed capacity (m.c.r. MW
	Coal	Coke and Breeze	Oil	Steam	Water power	Total†		
British Electricity Authority ...	2,945	98	7·1	5,498	27	5,531	5,193	18,641
N. of Scotland H.E.B.	15	1	1·0	22	76	103	101	567
Total for April, 1954	2,960	99	8·1	5,520	103	5,634	5,294	19,208
Corres. total for April, 1953 ...	2,839	73	4·5	5,180	77	5,269	4,958	17,709
Increase or decrease, per cent ...	+4·2	+35·6	+80·0	+6·6	+33·8	+6·9	+6·8	+8·5
Total to date (4 months), 1954 ...	13,916	419	56	25,438	525	26,016	24,497	
Total for corres. 4 months of 1953	12,966	344	30	23,229	383	23,672	22,304	
Increase or decrease, per cent ...	+7·3	+21·8	+86·7	+9·5	+37·1	+9·9	+9·8	

* Comprising all stations controlled by the British Electricity Authority and the North of Scotland H.E.B.
† Includes 7 million kWh generated by oil engines and 4 million kWh by waste heat plants in April, 1954.

Dust Nuisance

Further consideration is to be given by Newcastle-on-Tyne Health Committee to a proposal to prosecute the British Electricity Authority because of dust stated to be emitted on to parts of Newcastle from Dunston power station. The Committee has asked the Ministry of Fuel for technical advice on the matter. At a meeting of the Health Committee the opinion was expressed that if the Committee took proceedings against the B.E.A. and lost its case, it would still show that the Committee was doing what it could. The dust nuisance had lasted so long that people were beginning to doubt whether the Committee could deal with it.

Transmission Line

Derbyshire County Planning Committee has given its consent to the route of a 132 kV transmission line which will cross Derbyshire from the power station now in course of construction at Willington in the south of the county, to Winster in the north.

Terms for New Supplies

The Chilterns Local Committee of the Eastern Electricity Consultative Council recently had under consideration the charges for supplies to new consumers. It was recommended that the Council should suggest to the Board that an attempt should be made to co-ordinate with other Boards the principle under which these charges were made. Referring to this matter at a meeting of the Council in London last week the chairman (Ald. W. J. Bennett) said it was felt that there was justification, because of the differing bulk supply charges, for variations in tariffs, but capital charges incurred in providing supplies to new consumers did not materially differ, and it was thought that the Central Authority ought to give a lead on some standard method.

With regard to rural supplies, it was reported that the Board's new line rental charges represented a material improvement on the previous terms and the new arrangements were welcomed by the Council as offering a reasonable and convenient basis on which supplies could be brought to farms and other isolated premises.

Yorkshire Industrial Tariffs

At a meeting of the Yorkshire Electricity Consultative Council held in Leeds on 10th May, the Council received a report submitted by a committee which had been considering the Yorkshire Board's proposed standard industrial tariffs. The Council approved the tariffs but asked the Board to delay their introduction until October to prevent contract rates in orders already obtained by industrial consumers from being adversely affected.

In the report, the committee had made the point that approximately 70 per cent of the Board's costs were represented by the purchase of electricity from the Central Authority, and that the Council had not the opportunity of checking these charges. The Council resolved, therefore, that a letter should be sent to the Minister of Fuel and Power drawing attention to this point and suggesting that a representative of the Consultative Councils should be a member of the Central Authority, in the same manner as the chairman of a Consultative Council was a member of an Area Board.

The Council also suggested that analyses on a statistically sound basis should be carried out for all classes of load nationally with the object of basing future tariffs on sound and uniform principles and that a copy of this resolution should be forwarded to all other Consultative Councils.

Electricity on Farms

The North Western Electricity Consultative Council is to ask the Electricity Board whether its safety inspection of electrical wiring applies to farms. This was decided after Mr. J. E. Harrington had said that a representative of an agricultural insurance company had recently informed him that there had been many claims in respect of electrical accidents on farms. The chairman of the Council, Alderman F. Kenyon, said that recent discussions on safety inspection referred to domestic premises. The Board is also to be asked on behalf of farming interests whether it can give a rough timetable for its rural development programme throughout its area so that farmers can also make forward plans.

Turkish Hydro-Electric Plant

To supply electricity to the Rizi-Ordu district in North-Eastern Turkey, a hydro-electric plant is to be constructed at Ikizdere, on the Kizildere River, some 15 km south of Rize. The Turkish Ministry of Public Works estimates that the 15,540 kW plant will cost £T. 11 million and that a further £T. 3 million will be required for the necessary power lines. The project has been handed to the Iller Bank for execution, and it is understood that the Bank will invite tenders in the near future. Its address is: Iller Bankasi, Genel Müdürlügü, Ankara. Firms are asked to notify the Board of Trade Export Services Branch of any action taken, quoting E.S.B. 8221/54.

Kafue Choice Confirmed

Sir Roy Welensky, acting Prime Minister of the Central African Federation, replying recently to a speech by Mr. Garfield Todd, the Southern Rhodesian Prime Minister, confirmed that no change was contemplated in the Federal Government's decision to proceed first with the Kafue hydro-electric scheme. Mr. Todd had declared that new data showed that the larger Kariba project could produce power only a year after the production date of the Kafue scheme, and he said that this altered the premises on which the choice of Kafue had been made.

Street Lighting Conversion

Romford Council is to spend £9,720 on converting the lighting of 33 streets from gas to electricity.

Financial Section

STOCKS and SHARES

EXPECTATIONS of a cut in Bank Rate had been general enough to rob last week's announcement of any great surprise effect, except to the extent that it arrived ahead of estimates. In the gilt-edged market, the adjustment of the price level to conform with the new 3 per cent rate proved to have been completed mainly beforehand. In the industrial market the response has been more positive. Apart from its more technical aspects, a reduction in the rate is generally read as a sign of confidence in economic and business prospects. Without behaving spectacularly, share prices moved ahead. Then, partly as a sequel to political happenings at home and abroad, a certain amount of selling developed, and, in the absence of fresh buying, the general tone of markets became definitely easier. Nevertheless, many rises remain.

Electrical Equipment Shares

Improvements of about 1s in the prices of A.E.I., G.E.C., and English Electrics were typical of the extent to which the leaders in the industrial market reacted to the change in Bank Rate. With rises of half-a-crown in Parsons and 3s 9d in Reyrolles, these two occupied their now customary places in the van of any general advance. Mather & Platt at 70s are 4s higher; I.C.I. were marked up by a florin. Lancashire Dynamo became particularly prominent in gaining 3s, and others well to the fore included Automatic Telephones, Ericssons, Hoover, and Sturtevant. In the radio group, Ekcos were 3s 6d up, to 31s, but have since reacted by 1s or so.

Activity developed in Aerialites, which rose 9d to 11s 6d. Vactrics jumped to 13s 3d on news of the payment of arrears on the preference shares, which were called 22s 6d. Heatrae, on which the dividend is being maintained at 12½ per cent, changed hands at 4s 9d. Dewhurst, Pye, Brush, Dubilier and Hackbridge Cable all put on 6d to 9d, while Hackbridge & Hewittic were marked up 1s 9d to 21s 3d. Rises of 1s or so occurred in Cable & Wireless, B.E.T., R. A. Lister, Richardsons Westgarth, and Johnson & Phillips. Elliott Bros. were active and higher at 30s 6d.

British Electricity Stocks

Reactions in the prices of the British Electricity stocks to the cut in Bank Rate have been more restrained than was the case on the occasion of the similar change last September. Quotations then were marked up by about 30s per cent, whereas this time the improvements were at the most about 10s per cent, and there has been little follow-through to the initial adjustment. As suggested above, however, prices have been actively on the move for some time in anticipation of the Bank Rate reduction. A comparison of present prices with those ruling at the beginning of the year shows the relatively large improvement of 2

Week's Price Changes

Company or Board	Nom. Value	Middle price 17th May	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1954 Highest	1954 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	92		3	3	3 5 3	—	88⅞
Brit. Elec. 1974/77	100	91		3	3	3 6 0	—	87¼
Brit. Elec. 1976/79	100	96½	+½	3½	3½	3 12 6	97	93 11/16
Brit. Elec. 1974/79	100	105		4¼	4¼	4 1 0	105¼	103⅛
Overseas Electric Supply								
Calcutta Elec.	£1	20/-		6†	6†	6 0 0†	20/7	18/7
East African Power	£1	23/-		7	7	6 1 9	23/4	20/7
Nigerian Elec.	£1	23/6		10	10	8 10 3	25/-	23/6
Palestine Elec. "A"	£1	19/6	+6d	Nil	Nil	Nil	20/-	16/-
Perak Hydro-Elec.	£1	14/3	−3d	Nil	6	8 8 6	15/6	13/9
Equipment and Manufacturing								
Aberdare Cables	5/-	8/6		25	12½*	7 7 0	8/10	8/1
Aerialite	1/-	11/6xd	+9d	88¼	88¼	7 13 9	12/1	10/9
Allen, W. H.	£1	60/-		15	15	5 0 0	60/-	50/-
Aron Elec. Ord.	£1	47/6		15	20	8 8 6	47/6	43/-
Assoc. Elec. Ord.	£1	50/-	+1/6	20	11¼*	4 10 0	50/-	41/6
Automatic Tel. & El.	£1	71/3	+2/6	15	15	4 4 3	71/3	62/9
Babcock & Wilcox	£1	56/9	+6d	18	12*	4 4 6	57/-	47/3
Baldwin, H. J.	2/-	4/6		20	20	8 17 2	5/6	3/9
Bakelite	10/-	26/3	+6d	12½	12½	4 15 3	27/6	23/6
British Aluminium	£1	36/6	+1/-	12	10	5 9 6	40/-	34/6
B.I. Callender's	£1	42/-	+6d	10	10	4 15 3	44/-	37/9
B.I. Callender's 6% Pref. ...	£1	26/-		6	6	4 12 3	26/-	24/3
British Thermostat	5/-	28/9	+5/-	35	27½*	4 15 9	28/9	17/6
British Vac. Cleaner	5/-	12/9		25	25	9 16 0	14/6	11/6
Brook Motors	10/-	36/6		20	20*	5 9 6	36/6	33/3
Brush Ord.	5/-	6/6xd	+6d	4	6	4 12 3	7/-	3/6
Bulgin, A. F.	1/-	3/3		30	30	9 4 6	3/7	3/2
Burco	5/-	14/6xd	+3d	35	35	6 0 8*	14/6	12/1
Chloride El. Storage	£1	59/6	+3/3	20	12½*	4 4 0	59/6	46/6
Clarke Chapman	£1	56/3xb	−1/3	17½	20	—	57/6	47/6
Cole, E. K.	5/-	31/-	+3/6	25	25*	4 0 9	31/-	22/6
Cossor, A. C.	5/-	8/-		10	10	6 5 0	8/11	7/-
Crabtree	10/-	28/9	+1/3	17½	17½	6 1 6	28/9	23/9
Crompton Parkinson Ord. ...	5/-	17/9	−3d	11¼	20	5 12 9	18/-	14/-
De La Rue	5/-	13/9	+3d	35	Nil	Nil	14/10	12/3
Decca	4/-	38/3	+3d	150	35*	—	38/3	28/9
Desoutter	5/-	18/3		18	20	5 9 6	18/7	16/1
Dewhurst	2/-	6/-	+6d	19	19	6 6 9	6/3	5/1
Dictograph Tel.	2/-	6/-		20	20*	6 13 4	6/3	5/2
Dubilier Condenser	1/-	6/-	+9d	28	25*	4 3 4	5/9	4/1
E.M.I.	10/-	14/-		12	8	5 14 4	14/9	11/3
Electrical Components	5/-	11/3		20	20	8 17 10	11/6	10/9
Elec. Construction	£1	58/9		15	15	5 2 3	58/9	53/-
Enfield Cable Ord.	£1	20/9	−6d	5	Nil	Nil	22/3	16/6
English Electric	£1	45/9	+9d	15	10*	4 7 6	45/9	38/-
English Electric 3½% Pref. ...	£1	16/6		3½	3½	4 11 0	16/6	15/3
Ericsson Tel.	5/-	26/3	+1/-	22†	25†	2 7 9†*	26/3	22/9
Ever Ready	5/-	35/6xd	−1/6	35	40	5 12 9	37/-	26/-
Falk Stadelmann	£1	38/9		15	15	7 14 9	41/-	36/6
G.E.C. Ord.	£1	43/9	+1/3	22½	11¼*	5 2 9	43/9	37/6
G.E.C. 6½% Pref.	£1	27/-		6½	6½	4 16 3	27/3	26/6
General Cables	5/-	16/9		30	30	8 19 2	16/10	16/6
Greenwood & Batley	£1	43/9		15	17½	8 0 0	44/-	40/3
Hackbridge Cable	5/-	14/9	+6d	20	20	6 15 7	14/9	11/3
Hackbridge & Hewittic	5/-	21/3	+1/9	20	20	4 14 0	21/3	16/10
Hall Tel. Acc.	10/-	11/-		10	10	9 1 9	11/11	10/7
Heatrae	2/-	4/9	+6d	12½	12½	5 5 3	4/9	4/-
Henley's	10/-	18/3	+3d	10½	10½	5 15 0	18/3	15/6
Holophane	5/-	14/9		20	20	6 15 7	15/-	13/1

* After capital bonus † Free of income tax.

The above quotations are based upon middle prices in the Stock Exchange Daily Official List

points (without taking ex-dividend deductions into account) in both the 3 per cent Electricity Stocks, and of nearly as much in the 3½ per cent issue. The B.E.A.'s last issue, of £125 million 4¼ per cent stock, was made nearly a year ago, and another in the near future would cause no astonishment.

British Thermostat Dividend

Excellent results published by the British Thermostat Co. induced a further rise of 5s in the price of the 5s shares, to 28s 9d. They had already come up from 17s 6d during the course of this year. An expansion by nearly one-third in the net group profit (after a very much larger tax charge) provides comfortably for the raising of the ordinary distribution to 27½ per cent (including a bonus of 7½ per cent). Last year's total was equivalent to 17½ per cent on the present capital, as doubled subsequently by a share-for-share bonus. Dividends on preference and ordinary stocks still absorb this time barely a quarter of the surplus available, leaving the best part of £150,000 to be added to the reserves. Part of the latter are to be capitalized, subject to assent, in the distribution of another share bonus in the ratio of one for two. On the new basis, the yield on the shares becomes 4¾ per cent.

in Electrical Investments

Company or Board	Nom. Value	Middle price 17th May	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield £ s d	1954 Highest	1954 Lowest
Equipment and Manufacturing—continued.								
Hoover	5/-	35/9	+3/-	25	45	6 0 0	36/-	26/3
I.C.I.	£1	61/3	+2/-	13	15	4 18 0	61/3	52/9
Intl. Combustion	5/-	23/-	+6d	15	20	4 7 0	23/-	14/6
Johnson & Phillips	£1	49/6	+1/-	15	15	6 1 3	52/3	48/6
Lancashire Dynamo	£1	53/9	+3/-	12½	14	5 4 3	53/9	43/-
Laurence, Scott	5/-	19/9	+6d	15	20	5 1 3	19/9	14/-
Lister, R. A.	£1	42/-	+1/-	9	12	5 14 3	42/-	31/9
London Elec. Wire	£1	45/-xd	+6d	15	10*	4 9 0	45/-	38/-
Lucas, J.	£1	64/6	+9d	9⅛	10⅝	3 7 3	64/6	50/3
Marryat & Scott	2/-	6/6		22½	22½	6 18 6	6/6	5/11
Mather & Platt	£1	70/-	+4/-	12½	15	4 5 9	70/-	53/1
Metal Industries	£1	34/9	+6d	15	12*	6 18 0	42/3	29/6
Midland Elec. Mfg.	£1	67/6		15	15	4 9 0	67/6	63/-
Morphy-Richards	4/-	16/6	+6d	40	40	—	17/-	11/4
Murex	£1	55/6	+6d	15	15	5 8 0	56/3	50/-
Newman Ind.	2/-	2/3		10	10	8 17 9	2/6	2/-
Oldham & Son	1/-	3/-		35	17½*	5 16 8	3/4	2/5
Parnall (Yate)	5/-	6/3xd	+6d	6	8	6 8 0	6/6	4/3
Parsons, C. A.	£1	50/-	+2/6	12½	7½	3 0 0	50/-	38/1
Plessey	5/-	52/6	+3/9	25	30	2 17 3	53/-	37/10
Pye Deferred	5/-	24/-	+6d	18	20	—	24/-	15/7
Revo	10/-	18/6	+6d	27½	27½	—	18/6	16/7
Reyrolle	£1	81/3	+3/9	12½	13¾	3 7 0	81/3	66/-
Rheostatic	4/-	12/-		19	20	6 13 4	12/9	11/-
Richardsons Westgarth	5/-	13/3	+1/-	12	15	5 13 3	13/3	8/7
Scottish Cable	4/-	14/6		32	20*	4 11 6	14/6	12/11
Siemens Ord.	£1	43/-	+6d	10	10	4 13 0	43/9	34/9
Smith (England), S.	4/-	11/3	+9d	12½	15	—	11/3	7/8
Southern Areas	£1	19/6		5	6	6 3 0	20/-	17/6
Strand Elec.	5/-	8/3		17½	17½	10 12 3	9/3	8/6
Sturtevant	5/-	37/3	+1/3	18·1†	18·9*†	2 10 9†	37/3	29/-
Sun Elec.	£1	32/6		15	15	9 4 8	32/6	27/6
Switchgear & Cowans	5/-	12/9	+3d	22½	10	3 18 6	13/7	9/9
Taylor Tunnicliff	5/-	11/-		25	12½*	5 13 9	12/4	10/7
T.C.C.	10/-	30/-xb	+1/3	20	30*	—	30/-	21/3
T.C. & M.	£1	31/6	−6d	10	8½*	5 8 0	34/6	30/3
Telephone Mfg.	5/-	8/-	+3d	10	10	6 5 0	8/6	7/6
Thorn Elec.	5/-	17/6	+6d	12½	12½	3 11 5	17/6	13/3
Thornycroft	£1	38/9	+1/3	15	15	7 14 10	38/9	33/4
Tube Investments	£1	65/-		15*	15	4 14 0	68/9	60/3
Vactric	5/-	13/3	+2/-	Nil	Nil	Nil	13/3	7/6
Veritys	5/-	6/-		10	12½	10 8 3	8/3	5/-
Walsall Conduits	4/-	51/3	+1/3	70	70*	5 9 3	51/3	44/-
Ward & Goldstone	5/-	46/3		45	45*	4 17 3	46/3	41/3
Watford	2/-	6/-		25	22½*	—	6/3	4/7
Westinghouse Brake	£1	67/6	+6d	14	15	4 9 0	68/10	60/9
West, Allen	5/-	14/6		15	17½	6 0 9	15/3	12/7
Wolf Electric	5/-	12/3		15	17½	7 2 9	13/10	11/-
Trusts, Transport and Communications								
Anglo-Am. Tel.:								
4 Ord.	100	82½xd	+1	—	6	7 5 6	89½	—
Ord.	100	52½xd	−2	—	3¾	7 2 10	55½	52
Anglo-Portuguese	£1	23/-		8	8	6 19 2	23/4	21/-
Brit. Elec. Traction:								
Def. Ord.	5/-	46/6	+1/-	25	35	3 15 3	46/6	39/1
Cable & Wireless:								
Ord.	£1	40/-	+1/-	8	9	4 10 0	40/6	26/2
4% Loan	100	98½	+1	4	4	4 1 3	98½	95½
Calcutta Trams	£1	17/6		6†	2½†	—	19/3	17/1
Cape Elec. Trams	£1	15/-		5½	5½	7 6 8	15/3	12/4
Marconi Marine	£1	31/6	+3d	10	10	6 6 6	31/6	27/6
Oriental Tel. Ord.	£1	77/-		16	16	—	80/6	73/9
Telephone Props.	£1	4¾		8	8	—	5⅛	4¼
Telephone Rentals	5/-	10/3		10	10*	—	10/3	9/1

T.C. & M. Capital

At the ninetieth annual meeting of the Telegraph Construction & Maintenance Co. the chairman confirmed the company's intention, mentioned earlier in the report, of raising fresh capital by an issue of preference shares. Authorized capital is to be increased by the creation of a million £1 redeemable preference shares, of which half are to be issued. Terms and conditions are to be circulated to shareholders after the necessary meeting has been held on 4th June. In connection with these financial requirements, Lord Colgrain refers to the increasing activity of the company.

Southern Areas Progress

Market expectations were well satisfied with the increased earnings and dividend announced by Southern Areas Electric. A rise in net profits to nearly £100,000 carries on the improvement reported in each successive year since the reorientation of the business after the nationalization of the electricity supply interests six years ago. It bears out the good account of progress given in the last annual report concerning the several electrical and engineering subsidiaries which now make up the group. Last year, the company added a 1 per cent bonus to the 5 per cent dividend, and is now bringing the total up to 7½ per cent (of which 2½ per cent is described as bonus).

Company News

Chloride Electrical Storage £1 shares have risen by 3s 3d, to 59s 6d, since the publication of the full report. The price has quickly recovered all and more of the setback registered last month on momentary disappointment with the final dividend. This raised the total from the equivalent of 10 to 12½ per cent on the present capital. The dividends take less than a third of the surplus available for distribution and reserves. Henley's Telegraph shares hardened to 18s 3d after the appearance of the company's report, which is again notable for the strength of the balance sheet.

REPORTS and DIVIDENDS

W. T. Henley's Telegraph Works Co., Ltd.—The report and accounts for 1953 now issued show a consolidated trading profit of £1,350,003, as compared with £1,392,118 for the preceding year, and after adding investment income, this is raised to £1,541,608. Depreciation requires £268,149, taxation £578,699, and provision for maintenance on sundry contracts, £2,000, leaving a net balance of £692,760 (£522,398), to which is added £879,588 brought in and £199 settlement of war damage claim, making £1,572,547. General reserve receives £440,000 and it is proposed to pay a final ordinary dividend of 8 per cent, making 10½ per cent for the year. This compares with 13 per cent for 1952, when the interim dividend of 5 per cent was paid before the 100 per cent scrip issue.

The directors state that the subsidiary, Henley's Tyre & Rubber Co., Ltd., has recovered from the setback suffered last year sufficiently to turn the trading loss of that year into a profit, although after meeting depreciation and other charges that company is still not on a profit earning basis.

The British Vacuum Cleaner & Engineering Co., Ltd.—Presiding at the annual meeting held on 14th May, Mr. J. J. Hambidge (chairman and joint managing director) said that at the last year's meeting he gave a warning that the figures for the year now under review would be adversely affected by rising costs and the unfavourable trading conditions of the first six months as a result of the combined application of heavy purchase tax and consumer credit restrictions in the home market, and the continuance of import regulation of many overseas countries. As a result of the heavy setback in sales it became necessary to cut back production to a low corresponding level. Shortly after the last annual meeting a considerable improvement in the order book took place both in home and overseas markets, partly, so far as the home market was concerned, arising from some relief in purchase tax. From that time the order book continued to develop throughout the latter months of the year and is continued. In the remaining months it proved impossible to effectively gear up production to meet the suddenly expanded order book in the changed conditions. There was now a marked improvement in the general position and the outlook.

After referring to the effect of the suspension of two important Australian contracts, Mr. Hambidge gave particulars of the proposed acquisition by John Thompson, Ltd., of the company's shareholding in B.V.C. Industrial Constructions, Ltd. Under these arrangements John Thompson, Ltd., would pay to them three times the par value of their shares in B.V.C. Industrial Constructions, and in addition their finances would be liquefied by a sum of about £400,000. This would enable them to expand development of "Goblin" home appliances. These negotiations had been virtually concluded and a statement would shortly be made. They would be continuing production of most of the manufactures hitherto carried out in their shops. They would, however, be able to replan capacity of the works to provide facilities for domestic appliances, etc. Regarding the outlook, the chairman said that there had been substantial improvement in the first half of the current year. Vacuum cleaner sales showed a considerable increase over those of the same period last year, and washing machine sales had taken a great move forward almost commensurate with that of cleaners.

The Chloride Electrical Storage Co., Ltd.—The preliminary figures for 1953 given in our issue of 23rd April are confirmed in the report and accounts now issued.

In his accompanying statement, Mr. A. W. Browne (chairman) says that the net result for the year is almost 50 per cent greater than last year's figure. Although the sales for the first three months of the year did not compare favourably with the figures for the corresponding period of the previous year, there was a marked improvement during the remainder of the year, the result being that at the year end the volume of business for the group was only slightly less than for 1952. The most striking feature of the business has been the reception of the "Silver-Exide" range of standard batteries for motor-car starting and lighting. In this range the adoption of "Porvic" separators has enabled full advantage to be taken of the many improvements in plate manufacture which have been made in recent years. The demand for batteries for the propulsion of electric road vehicles has been maintained, and there has been a further increase in the field of factory trucks, particularly the fork lift type. The use of battery locomotives for underground haulage, both by the National Coal Board and by various mining companies overseas, continues to expand. The results from the alkaline battery business have exceeded those of the previous year; the order books are sufficient for six months at the present rate of production, and 40 per cent of the orders are for export. The engineering activities of the larger manufacturing companies have continued to expand; the volume of development work, both for commercial application and the Services, shows no sign of falling off.

The total volume of export business has been well maintained in spite of the difficulties of import restrictions and exchange in some markets. Orders began to improve towards the end of the year, and to date show a considerable increase compared with the same period of the previous year. A controlling interest has been acquired in the Hart Battery Co., of Montreal, Canada. Extensions of the factories in Australia and New Zealand have been completed and are operating satisfactorily. The new buildings in India have been finished and additional plant is being installed which it is expected will be working by the end of the current year. A new factory at East London, South Africa, is now producing "Silver-Exide" batteries.

Parnall (Yate), Ltd.—The annual meeting will be held on 31st May. In his circulated statement, the Earl of Limerick (chairman) says that sales of washing machines during 1953 were more than three times the volume in the previous year, and for the first three months of the current year these sales have shown further improvement. The demand for wringers was less than for the previous year. The reception of the "Ezy-Press" ironer, which is being manufactured under licence, has been good. Sales of cookers decreased compared with 1952, and this was due mainly to the greater demand on the works' capacity for washing machine production.

Exports for 1953 showed a 20 per cent increase compared with 1952; this related to the company's own products, and not to products made under contract for other companies. Since the end of the year, a wholly owned subsidiary, Parnall (Australia) Pty., Ltd., has been formed to look after the interests of the group in Australia.

The Automatic Telephone & Electric Co., Ltd.—The annual general meeting will be held on 9th June. In his circulated statement Sir Alexander Roger (chairman) says that sales of telephone equipment have again been limited by Treasury restrictions on Post Office capital expenditure. Sales overseas, although showing some reduction on 1952, have been maintained at a satisfactory level. In the past it has been possible, to some extent, to pass on to the customer the increased costs resulting from high wage rates. The position had now been reached, however, where higher prices will mean loss of business in the export markets.

The British Thermostat Co., Ltd. in a preliminary statement, shows a group profit attributable to the parent company of £198,499 for the year ended 31st January last, after providing £274,550 for taxation. This compares with a profit of £150,097 for the previous year. General reserve receives £90,116. It is proposed to pay a final dividend of 12½ per cent and a bonus of 7½ per cent making 27½ per cent for

the year on capital doubled by a scrip issue. The dividend for the previous year on the smaller capital was 35 per cent. A balance of £363,459 is carried forward (against £309,072 brought in). Subject to permission of the Capital Issues Committee, it is proposed to issue one new ordinary share for every two shares now held.

Richard Johnson & Nephew, Ltd., in a preliminary statement, show that after providing £382,040 for taxation, the net profit for the year to 27th March last is £386,159, as compared with £438,000 for 1952–53. General reserve receives £315,209, and it is proposed to pay a final dividend of 4 per cent, maintaining the distribution for the year at 6 per cent.

The River Plate Electricity and Other Securities Corporation shows a net profit for the year ended 30th April last of £48,409, as compared with £41,698 for 1952–53. General reserve receives £10,000, and it is proposed to pay a final dividend of 8 per cent (against 7 per cent), making 12 per cent (10 per cent) for the year. The balance carried forward is £20,983 (against £19,854 brought in).

J. G. Statter & Co., Ltd., held extraordinary general meetings recently when resolutions were passed authorizing an increase in the ordinary share capital from £30,000 to £250,000 (all in 1s shares), the capitalization of reserves and undistributed profits, and a bonus issue of 2,400,000 1s ordinary shares in the ratio of four fully paid shares for each share held.

The Southern Areas Electric Corporation, Ltd.—A profit of £284,781 (before depreciation, taxation, etc.) is shown for last year, against £265,600 for 1952. Taxation requires £118,426, and the net profit is £99,771 (£82,460), of which £79,468 is dealt with in the accounts of the holding company. General reserve receives £37,750, and it is proposed to pay a dividend for the year of 5 per cent (same), plus a bonus of 2½ per cent (against 1 per cent). The balance carried forward is £215,348 (against £127,926 brought in).

The Power Securities Corporation, Ltd., reports a group net profit for 1953, after deducting £284,364 for taxation, of £155,150, as compared with £140,313 for 1952. It is proposed to pay a dividend for the year of 8 per cent (against 7 per cent).

Vactric, Ltd.—The directors have announced that payment will be made on 1st June next of the 6 per cent preference dividend due in respect of the half-year ended 27th March last, together with the balance and the arrears relating to the preceding 3½ years.

Heatrae, Ltd.—A net profit of £10,529 is reported for the year ended 28th February last, as compared with £11,464 for the preceding year. General reserve receives £5,000 and the ordinary dividend for the year is maintained at 12½ per cent. The balance carried forward is £25,036 (against £23,769 brought in).

G. N. Haden & Sons, Ltd., report a trading profit for 1953 of £228,903, as compared with £199,222 for 1952. Taxation absorbs £142,968. The ordinary dividend for the year is unchanged at 15 per cent.

The Lisbon Electric Tramways, Ltd., reports a profit of £79,249 for 1953, as compared with £69,739 for 1952. It is proposed to pay a final dividend of 4 per cent (against 2½ per cent), making 6½ per cent (5 per cent), tax free, for the year.

Liquidations

L. B. Griffiths, Ltd., radio relay service proprietors and radio and television retailers.—Winding up voluntarily. Liquidator, Mr. S. Chater, 35, Windsor Place, Cardiff, appointed 30th April.

Electrical Power Specialists (Hendon), Ltd.—Particulars of claims by 8th June to the liquidator, Mr. A. W. Hunter, Walter House, 418–422, Strand, London, W.C.2.

Whittaker Electrical Products, Ltd., radio and television retailers.—Winding up voluntarily. Liquidator, Mr. E. Benjamin, 57, Blandford Street, London, W.1, appointed 30th April.

Electric Tool Development Co., Ltd.—Meeting 14th June at 9, Ironmonger Lane, London, E.C.2, to receive an account of the winding-up by the liquidator, Mr. D. A. Lumley.

Edolite Lamps, Ltd.—Winding-up order made 3rd May.

Bankruptcies

R. V. Mayner, 62, Harris Street, Peterborough, electrical engineer, lately carrying on business at Narrow Street and Wentworth Street, Peterborough.—Last day for receiving proofs for dividend 28th May. Trustee, Mr. C. A. Taylor, 41, Sidney Street, Cambridge, Official Receiver.

A. J. Digby, 238, Walworth Road, London, S.E.17, and 22F, Doughty Mews, W.C.1, electrical contractor, lately carrying on business at 8, Doughty Mews, W.C.1.—First and final dividend of 1s 8d in the £, payable on and after 18th May at Bankruptcy Buildings, Carey Street, London, W.C.2.

J. D. Stuart, 22, Yarra Road, Cleethorpes, Lincs., journeyman electrician.—Trustee, Mr. H. S. Bloomer, 8, Flottergate, Great Grimsby, Official Receiver, released 7th May.

J. C. R. Gillitt, 19, Stangrove Road, Edenbridge, Kent, electrical contractor.—Receiving order made on 11th May on debtor's own petition.

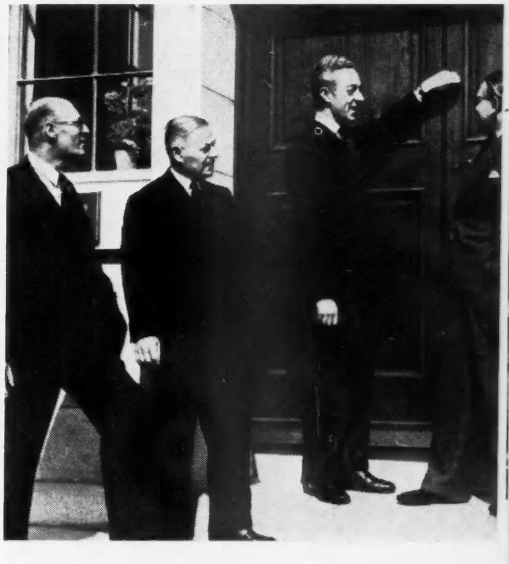
New Ulster Cable Factory

A NEW factory for Irish Cables, Ltd., was officially opened at Newcastle, Co. Down, on 10th May, by Lord Glentoran, the Northern Ireland Minister of Commerce. The building is one of the factories erected by the Ulster Government and let to suitable tenants. The factory, which has been operating on some lines for three months, is designed to manufacture all types of cables from automobile types to the heaviest electrical conductors.

At a luncheon preceding the opening, Lord Glentoran said his main task was to get more work for their unemployed people and in this factory they had an entirely new industry in their province. It was important for them to have such a diversification as the new factory represented, in order to offset any slump which might occur in their main industries such as linen or shipbuilding.

Mr. W. L. Wray, managing director of Irish Cables, Ltd., said that the imports of cables into Northern Ireland amounted to about three-quarters of a million pounds annually. This was rapidly growing due to the development of new industries and rural electrification. In the Newcastle factory they hoped to concentrate on the manufacture of telephone cables and cables for house wiring, and also a wide range of cables for the radio and electronics industries and cables for rural electrification. Plans were already completed for a large extension to the works. Other speakers were Mr. Hugo Falk, of Falk, Stadelmann & Co., the parent company, Mr. Brian Faulkner, M.P., and Sir William M'Cleery (former Minister of Commerce).

Lord Glentoran opening the new factory of Irish Cables, Ltd. On the left are Lt. Col. Geoffrey Falk (director) and Mr. Hugo Falk and on the right Mr. W. L. Wray (managing director)



NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (2s 8d each including postage) will be obtainable after 30th June from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1949

2411. Western Electric Co., Inc.—Electron camera tubes. 28th January, 1949. Cognate application 2412, 29th January. (711202.)

16698. Telephone Manufacturing Co., Ltd. —Impedance networks. 20th June, 1950. (711207.)

18749. Aron Electricity Meter, Ltd., and Riordan, E. J.—Price-changing mechanisms for prepayment meters. 17th July, 1950. (711341.)

1950

4059. Electric & Musical Industries, Ltd.— Apparatus for reproducing pictures from television signals and especially apparatus for recording such pictures on kinematograph film. 19th February, 1951. (711263.)

6949. Hurry Heaters (1948), Ltd., and Darby, H. G.—Water heaters. 21st June, 1951. (711264.)

19341. Marconi's Wireless Telegraph Co., Ltd.—Apparatus for televising from kinematograph film and the converse. 22nd October, 1951. (711268.)

29016. Marconi's Wireless Telegraph Co., Ltd.—Radar systems. 11th October, 1951. (711273.)

30712. Electric & Musical Industries, Ltd.— Circuit arrangement employing cathode-ray tubes. 6th December, 1951. (711275.)

1951

3701. Robertshaw-Fulton Controls Co.— Thermostatically operated electric switches. 15th February, 1951. (711218.)

4347. General Electric Co., Ltd., and Sherwen, J. W.—Vibratory conveyors and the like. 22nd February, 1952. (711277.)

6759. Akt.-Ges. für Technische Studien.— Process for protecting heat resistant metal parts against damage by high temperatures. 21st March, 1951. (711347.)

8056. Midgley, A. H., and Midgley, A. M.—Electric interrupter switches. 7th April, 1952. Cognate application 9735, 26th April, 1951. (711348.)

11829. Midgley, A. H., and Midgley, A. M.—Electric interrupter switches. 21st April, 1952. Cognate application 2074, 25th May, 1952. (711351.)

12403. Bernd, A.—Electric flow heaters. 28th May, 1951. (711354.)

16108. Isopad, Ltd., and Reik, H.—Electric heating mantles. 12th June, 1952. (711365.)

17060. National Research Development Corporation.—Gaseous discharge tube circuits. 18th July, 1952. (711431.)

20010. Autelca Akt.-Ges.—Electric current impulse transmitter. 24th August, 1951. (711368.)

21884. British Thomson-Houston Co., Ltd. —Sound transmitting and reproducing systems. 11th July, 1952. (711370.)

23473. British Thomson-Houston Co., Ltd. —Methods for the adhesion of organopolysiloxanes to solid surfaces. 9th October, 1951. (711374.)

25494. Marconi's Wireless Telegraph Co., Ltd.—Radio direction finders. 2nd July, 1952. Cognate application 7801, 26th March, 1952. (711377.)

25598. Marconi's Wireless Telegraph Co., Ltd.—Very high frequency cavity resonators. 31st July, 1952. (711378.)

26804. General Electric Co., Ltd., and Bilsland, G. A.—Electric cooking apparatus. 24th October, 1952. (711300.)

28594. Hoover, Ltd.—Handle propelled suction cleaners. 6th December, 1951. (711383.)

1952

1411. Belling & Lee, Ltd.—Thermally operated electric overload circuit breakers. September 5, 1952. (711391.)

2248. Pirelli-General Cable Works, Ltd., and Penrose, J. R.—Electric cables. 8th December, 1952. (711305.)

2474. Morton, C.—Differential d.c. amplifiers. 19th December, 1952. (711440.)

3967. Petralias, N. A.—Voltage regulator equipment for a.c. generators. 14th February, 1952. (711397.)

4085. Bailey Meters & Controls, Ltd.— Balanceable electric networks. 15th February, 1952. (711398.)

6745. Siemens & Halske Akt.-Ges.— Compensation for extraneous voltages transmitted by long-distance current supply into the symmetrical line circuits. 14th March, 1952. (711400.)

8266. Metal & Thermit Corporation.— Electrodeposition of tin-zinc alloys. 1st April, 1952. (711403.)

10167. General Electric Co., Ltd.—Demodulators for pulse amplitude modulated electric signals. 22nd April, 1953. (711409.)

12339. Bagh, A.—Electrical distribution installations. 15th May, 1952. (711413.)

13577. Metropolitan-Vickers Electrical Co., Ltd.—Turning gear for steam turbines. 8th May, 1953. (711250.)

18043. Siemens & Halske Akt.-Ges.— Circuit arrangements for telecommunication installations having relay switches. 16th July, 1952. (711318.)

20625. Marconi's Wireless Telegraph Co., Ltd.—Electrical recording apparatus. 1st April, 1953. (711323.)

21125. Philco Corporation.—Magnetic deflection systems for cathode-ray tubes. 22nd August, 1952. (711325.)

21442. Hoover, Ltd.—Suction cleaners. 26th August, 1952. (711255.)

25628. Siemens & Halske Akt.-Ges.— Selectors for telecommunication installations. 13th October, 1952. Addition to 710200. (711257.)

30265. Babcock & Wilcox, Ltd.—Method of an apparatus for controlling the temperature of superheated steam and the temperature of reheated steam in a steam generating unit. 28th November, 1952. (711457.)

32622. General Electric Co. — Valve-actuating mechanism. 23rd December, 1952. (711338.)

1953

3703. Pirelli Soc. Per Azioni.—Electric cables. 10th February, 1953. (711460.)

4266. Telephone Manufacturing Co., Ltd. —Impedance networks. 20th June, 1950. Divided out of 711207. (711260.)

Swedish Imports Exceed Exports

IN Sweden's external electrical trade last year the excess of imports over exports was rather larger than in 1952. The value of imports was Kr. 307 million and of exports Kr. 285·6 million, both decreases of about Kr. 45 million on the previous year. The accompanying table gives the values of the chief groups in 1953 with notes of increases or decreases as compared with the previous year.

On the import side the only outstanding exception to the decline was in electro-medical apparatus, while among exports an increase was noteworthy in telegraph and telephone apparatus, thus making it the most valuable group in the list. For electrical goods generally the leading customer countries were Norway, Poland, Brazil, Denmark, the Netherlands and Spain, while principal suppliers were Western Germany, the United Kingdom and the United States. (14·5 Kr. = £1.)

Class of Goods	IMPORTS		EXPORTS	
	1953 Kr. (000)	Inc. or dec. on 1952 Kr. (000)	1953 Kr. (000)	Inc. or dec. on 1952 Kr. (000)
Generators, motors, convertors, etc.	67,253	− 2,499	52,845	− 29,161
Vacuum cleaners, fans, etc.	34,665	− 1,063	30,353	− 10,595
Stators, rotors, current collectors, etc.	6,184	− 3,063	2,072	+ 1,482
Accumulators	1,983	− 87	19,240	+ 1,978
Battery parts	3,965	+ 526	—	—
Lamps, metal filament	5,064	− 95	1,049	− 110
Lamps, mercury vapour, etc.	12,543	+ 1,832	—	—
Carbons for electro-technical purposes	12,190	− 2,757	526	− 99
Starting, regulating, control and switch apparatus	28,260	− 534	22,664	− 15,348
Porcelain insulators	1,454	− 654	—	—
Cable, metalclad	14,822	− 29,935	7,724	+ 3,054
Cable, other	8,335	− 12,289		
Elec. stoves, fires, etc.	2,259	+ 1,101	2,377	− 576
Electric meters	9,336	− 808	2,976	− 2,208
Telegraph and telephone apparatus	3,548	− 767	85,903	+ 7,528
Radio apparatus, valves, etc.	29,616	− 5,189	14,984	+ 942
Electromedical, etc., apparatus	65,941	+ 14,155	5,395	+ 213
Röntgen tubes	1,227	− 705	606	− 198

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Ashford (Kent).—12th June. U.D.C. Street lighting equipment. (See this issue.)

Australia. — BRISBANE. — 25th June. City Council. Distribution transformers, ranging from 200 kVA to 1,000 kVA. (E.S.B. 11670/54. Ten/9205.)*

Belfast.—28th May. Northern Ireland Hospital Authority. Electrical installation at St. Luke's Hospital, Armagh. Chief engineer, Victory Buildings, 44–46, Queen Street.

Belgium.—BRUSSELS.—Service Général des Constructions Militaires. Lighting equipment at the Weelde airfield. (E.S.B. 12455/54. Ten/9275.)*

Birmingham.—5th June. Tame and Rea District Drainage Board. Double acting variable speed duplex pump, electrically driven. Engineer to the Board, Rookery Park, Erdington.

Canada. — WINNIPEG. — 31st May. City Hydro-Electric System. Disconnecting switches. (E.S.B. 11951/53. Ten/9217.)*

Co. Down.—3rd June. Education Committee. Electrical installation at Newtownbreda Primary School. A. N. Irens, consulting engineer, 58, Howard Street, Belfast.

Formosa. — TAIPEI. — 8th June. Taiwen Power Co. Earthing equipment for common neutral of three main generator units. (E.S.B. 10857/54. Ten/9204.)*

Glasgow.—28th May. Corporation. Aerial cable. (See this issue.)

India.—MADRAS.—14th June. Madras Electricity Department. 212 11 kV/400 V and 115 22 kV/400 V transformers ranging from 50 kVA to 150 kVA. (E.S.B. 12394/54. Ten/9262.)*

Keynsham.—1st June. U.D.C. Electrical installations in 124 houses now being erected on the Park West estate. Surveyor, Council Offices.

Manchester.—16th June. Waterworks Committee. Water turbine, with pipes, valves, etc., two centrifugal pumps, main switch and motor starting gear, water metering and pump control gear, pipes, valves, strainers, etc., at Haweswater, Westmorland. (See this issue.)

Morocco. — TANGIER. — 7th June. Telefonica de Tanger S.A. Lead covered copper wire cables. (E.S.B. 11830/54. Ten/9223.)*

New Zealand.—WELLINGTON.—15th June. Post and Telegraph Department. Radio valves. (E.S.B. 12150/54. Ten/9259.)*

AUCKLAND.—5th July. Auckland Hospital Board. Diagnostic X-ray equipment. (E.S.B. 12298/54. Ten/9264.)*

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

Pakistan.—KARACHI.—7th June. Posts & Telegraphs Department. Radio equipment for establishing a telephone circuit between Peshawar and Chitral. 8th June. V.h.f. equipment for opening public call offices. (E.S.B. 12170/54. Ten/9249.)*

Preston.—10th June. Borough Council. Renewal of electrical installation at the Harris Library, Art Gallery and Museum. Borough surveyor, Municipal Buildings.

Saudi Arabia.—JEDDA.—29th May. Ministry of Communications. Fifty communications receivers. (E.S.B. 11938/54. Ten/9263.)*

31st May. V.h.f. telephone system. (E.S.B. 12366/54. Ten/9268.)*

21st June. Ministry of Communications. Telephone cable and accessories. (E.S.B. 11938/54. Ten/9230.)*

Sedgley.—8th June. U.D.C. Street lighting equipment. (See this issue.)

South Africa.—JOHANNESBURG.—3rd June. Stores Department, South African Railways. 250 table telephones and 20 10-line switchboards. (E.S.B. 11751/54. Ten/9206.)* Electric cable. (E.S.B. 11753/54. Ten/9212.)*

PRETORIA.—3rd June. Union Tender & Supplies Board. 4,000 cable markers. (E.S.B. 11927/54. Ten/9235.)* Generating sets ranging from 1·9 kVA to 7 kVA. (E.S.B. 11934/54. Ten/9232.)* Aerial contactors for radio beacons. (E.S.B. 11937/54. Ten/9234.)*

Turkey.—ANKARA.—7th June. Posts, Telephones and Telegraphs. 35,000 metres of telephone cord. (E.S.B. 12407/54. Ten/9269.)*

ISTANBUL.—7th June. Electricity, Tramways & Tunnel Administration. Twenty trolley-buses. (E.S.B. 4532/52. Ten/8407A.)*

United States.—PORTLAND, OREGON.—1st June. Bonneville Power Administration. Power circuit breakers. (E.S.B. 12248/54. Ten 9244.)*

TACOMA.—City Department of Utilities. Hydraulic turbines and generators for the Cowlitz Power Development. (E.S.B. 11001/54. Ten/9241.)*

ORDERS PLACED

Durham.—County Education Committee. Electrical installation in Heighington Redworth Hall Special Residential School (£1,937).—R. Robson.

Hythe (Kent).—U.D.C. Trunk road A259 street lighting.—Cohen Bros. (Electrical).

London.—ST. MARYLEBONE.—General Purposes Committee. Recommended. Renewal of mains and electrical circuits in the Town Hall (£4,825).—Higgins & Cattle.

Nantwich (Ches.).—Manchester Regional Hospital Board. Recommended. Improvements to the electricity supply at Barony Hospital, Nantwich (£2,709).—Hallams (Electrical Contractors).

Newcastle-under-Lyme. — Highways Committee. Recommended. Supply and erection of equipment for Class "A" lighting installations in various classified roads (£5,073).—Revo Electric Co.

Scunthorpe.—Corporation. Recommended. Electrical installations in 104 houses on the New Brumby and Church Farm estates (£2,860).—H. Hall.

Stevenage.—Electrical installations in 622 dwellings on the Marymead site, Stevenage New Town.—Stevenage Electrical Engineering Co., Ltd.

Wigan.—Erection of factory at Kitt Green; H. J. Heinz, Ltd., Harlesden, London, N.W.10.

Willesden.—Rebuilding factory and offices; Allnatt (London), Ltd., Park Royal Road, N.W.10.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Accrington.—Bus terminus, Peel Street; borough engineer.

Ayr.—Workshops, warehouse and offices, Peebles Street; Globe & Simpson, Ltd., 184, West Street, Sheffield.

Houses (40), Craigie site; Cowie & Torry, architects, 5, Wellington Square.

Bath.—Flats (32), Snow Hill; Snailum, Huggins & Le Fevre, architects, 18, Brock Street.

Bedlington.—Glove factory for Rema, Ltd.; S. J. Stephenson & Gillis, architects, 2, Saville Chambers, North Street, Newcastle-on-Tyne.

Birmingham.—Twelve shops and 15 flats, Edlewood Road, Rednal; J. Ashmore, Ltd., builders, Bromford Lane, West Bromwich.

Blackburn. — Departmental store, Church Street and Victoria Street; Littlewoods Mail Order Stores, Ltd., 152a, London Road, Liverpool.

Blackpool.—Factory, Back Collins Avenue; Sunnytops (Distributors), Ltd., 217, Newton Drive.

Bradford.—Residential wing and assembly hall at Margaret McMillan Training College; M. Harrison & Co. (Leeds), Ltd., Post Hill Quarries, Farnley, Leeds.

Houses (720), Halifax Road estate; city engineer.

Brighton.—Factory, East Moulsecoomb; Clayton & Black and Partners, architects, 10, Prince Albert Street.

Sixteen flats, Albion Hill; John W. Ridge, Ltd., builders, 42, Portland Street.

Bristol.—Large office block at Baldwin Street/Queen Charlotte Street site (£151,500); Royal London Mutual Insurance Society, Ltd., Royal London House, Finsbury Square, London, E.C.2.

Brownhills.—Houses (884) during the next two years; C. H. Hunt, U.D.C. surveyor, Coombe House, Brownhills, near Walsall.

Chatham.—Dwellings (72), Weeds Wood estate; borough surveyor.

Chester.—Extensions at 27 Bridge Street for Chester Chronicle & Associated Newspapers, Ltd.; Wm. Vernon & Son, Ltd., 57, Upper Northgate Street.

Cippenham (Slough).—Aged persons' home, for Bucks C.C.; F. A. Maunder, county architect, County Offices, Walton Street, Aylesbury.

Cirencester.—Houses (106), New Mill estate; E. Cole, architect, 13, Imperial Square, Cheltenham.

Colnbrook.—Works extensions for Copperad, Ltd.; Leightons (Ctrs), Ltd., 10, Chandos Street, London, W.1.

Cumberland.—R.C. secondary modern school at Cleator Moor; county architect, Portland Square, Carlisle.

Derby.—Gynæcological department at Derbyshire Hospital for Women; Naylor, Sale & Widdows, architects, St. Marys Gate, Derby.

Diss.—Laboratory block for Grammar School; education architect, Stracey Road, Norwich.

Dundee.—Houses (126), Douglas site; Atholl Houses, Ltd., Barfillan Drive, Glasgow.

Dunstable.—Large extensions to works (about £2,000,000); Vauxhall Motors, Ltd., Kingston Road, Luton.

Durham.—Old people's hostel at Crook (£10,000); Bell & Ridley, builders, North Road, Durham.

Enfield.—Two-storey block of offices in Great Cambridge Road; Spencer, Heath & George, gymnasium outfitters, Garfield Road.

Eston (Yorks).—Houses (46) on the Redcar Road East estate for the U.D.C.; N. C. Harrison, surveyor, Normanby Road, South Bank.

Fawley.—Large extensions to oil refinery; Esso Petroleum Co., Ltd., refiners, Fawley, near Southampton.

Fleetwood.—Showrooms and stores in Lord Street; Hearnshaws Stores, house furnishers, 52, Lord Street.

Gateshead.—Extensions and new building, West Street, for Shepherds, Ltd.; R. W. Bell & Co., Mistletoe Street, Newcastle-on-Tyne.

Hook (Surrey).—Laboratories and offices in Cox Lane; Allied Bakeries Research Laboratories, Ltd., Kemp Road, Dagenham.

Huyton-with-Roby.—Eleven shops and 18 flats, John's Road East; U.D.C. surveyor.

Hyde.—Factory for T. Wall & Sons, Ltd.; Sir Robert McAlpine & Sons, Ltd., 80, Park Lane, London, W.1.

Keighley.—Factory and offices at Riddlesden; Fred Hurtley, Ltd., hosiery manufacturers, Victoria Park Mills.

Kidderminster. — Reconstruction of portion of mills; Carpet Manufacturing Co., Ltd., New Road.

Leek.—Dwellings (76), Norton Green estate; Forshaw, Massey & Greaves, architects, 73, Trinity Street, Hanley.

Liverpool.—Hotel at Woolton for Peter Walker (Warrington), Ltd.; Gornall Kelly & Partners, architects, 155, The Albany, Liverpool.

London. — HCLBORN. — Office block, Fisher Street and Eagle Street; Rush & Tompkins, Ltd., 109, Station Road, Sidcup.

ISLINGTON.—Dwellings (98), Dame Street; Gee, Walker & Slater, Ltd., builders, 100, Park Lane, W.1.

STOKE NEWINGTON.—Warehouse extensions, Newington Green; Oxo, Ltd., Thames House, Queen Street Place, E.C.4.

Lydney.—Council offices; Rainger, Rogers & Smithson, architects to R.D.C., 29, Rodney Road, Cheltenham.

Milford Haven.—Shops, maisonnettes and flats on the Picton Road/Wellington Road site; surveyor, Urban Council Offices.

Oundle and Thrapston.—Two water pumping stations, Barnwell; Pick, Everard, Keay & Gimson, engineers to R.D.C., 6, Millstone Lane, Leicester.

Rugby.—Adaptations at Fawsley House to provide home for old people and staff; G. R. Barnsley, county architect, Shire Hall, Warwick.

West Bromwich.—Factory, Lyttleton Hall estate; Bearwood Roll & Tool Co., Ltd., 350, Bearwood Road, Smethwick.

Industrial Safety Conference

Over 600 safety officers, welfare officers and executives, representing industry in all parts of the British Isles, attended the annual National Industrial Safety Conference, organized by the Royal Society for the Prevention of Accidents at Scarborough from 14th to 16th May.

The delegates were welcomed by the Mayor of Scarborough. Illness prevented the Society's president, Sir Charles Bartlett, from attending, and in his absence his address to the conference was read by Mr. H. R. Payne, O.B.E., chairman of the National Industrial Safety Committee.

Among the papers presented was one on the safe use of electricity by Mr. S. J. Emerson, Deputy Senior Electrical Inspector of Factories.

Mr. Emerson confined his paper to the ordinary type of apparatus with which a works engineer deals in his day-to-day duties and not with the more complicated apparatus such as that found in power stations and substations. There was, he said, a tendency in industry to take the dangers of electricity too lightly and each year a number of fatal and non-fatal accidents occurred which might well, with a little care, have been prevented. When shock occurred the necessity for prompt and continued application of artificial respiration could not be overemphasized; there had been many instances where victims of electric shock had revived from apparent death after several hours' treatment.

Portable tools should be regularly and frequently tested, particular attention being paid to the flexible cable and its connections and to the continuity of the earth conductor. Mr. Emerson condemned the not uncommon makeshift arrangement of a portable lamp consisting of a non-earthed brass lampholder with lamp connected to a pair of flexible cables, which had been responsible for more fatal accidents than any other single piece of apparatus.

NEXT WEEK'S EVENTS

Organizers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged

Monday, 24th May, to Friday, 28th May

MARGATE.—Winter Gardens. Electrical Trades Union. Annual Policy Conference.

Tuesday, 25th May

LONDON.—Great George Street, S.W.1, 5.30 p.m. Joint meeting of the Institution of Civil Engineers and the Institution of Electrical Engineers. "The Owen Falls, Uganda Hydro-Electric Development — General Aspects," by Sir Charles Westlake, T. A. L. Paton, and R. W. Mountain.

Manson House, Portland Place, 6 p.m. Society of Instrument Technology. Annual general meeting followed by "Gadgets" evening.

SANDMOOR.—Sandmoor Golf Course. I.E.E. North Midland Centre. Annual Golf Competition.

Wednesday, 26th May

ABINGER COMMON.—I.E.E. London Students' Section. Visit to Royal Greenwich Observatory, Abinger Magnetic Station, at 2.30 p.m.

GLASGOW.—At the I.E.S. Building, Elmbank Crescent, 7 p.m. I.E.E. Scottish Centre annual general meeting followed by address by Scottish Centre chairman, Mr. C. H. A. Collyns.

LONDON.—Savoy Place, 5.30 p.m. I.E.E. Supply Section. Annual lecture: "Electrical Power Demand and Supply in the United States and the Role of Research in the Quarter Century Ahead," by Philip Sporn.

NOTTINGHAM.—I.E.S. Nottingham Centre. Spring outing to Royal Crown Derby Porcelain Works.

Wednesday, 26th May, to Saturday, 29th May

BELFAST.—Balmoral, Royal Ulster Agricultural Show.

Thursday, 27th May

BIRMINGHAM.—James Watt Institute, Great Charles Street, 6 p.m. Institute of Fuel, Midland Section. Annual general meeting.

LONDON.—Savoy Place, 5.30 p.m. Institution of Electrical Engineers. "Development and Utilization of Hydro-Electric Power in Uganda," by J. M. Stock and J. C. Lithgow. (Supply Section paper.)

At the Institution of Civil Engineers, Great George Street, S.W.1. Association of Consulting Engineers. Annual general meeting.

164, Shaftesbury Avenue, 7 p.m. Television Society. Annual general meeting.

Friday, 28th May, to Saturday, 29th May

LONDON.—I.E.E. Utilization Section. Section summer visit.

Saturday, 29th May

LONDON.—I.E.E. London Students' Section. Visit to the Long Distance Telephone Exchange, Faraday Building, Queen Victoria Street, E.C.4, at 10 a.m.